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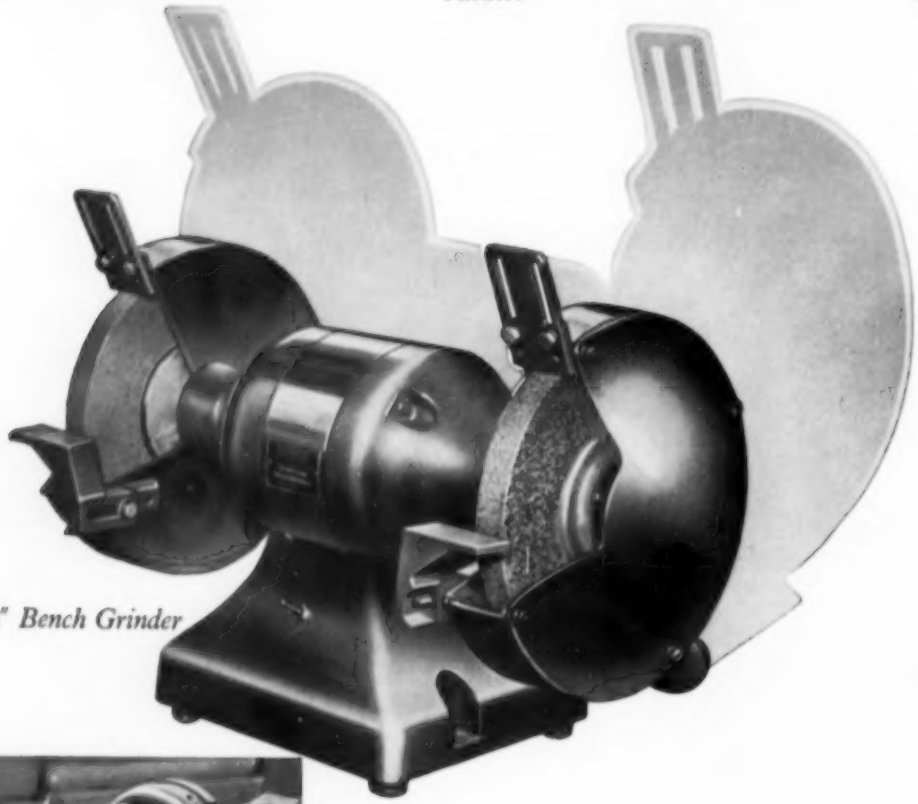

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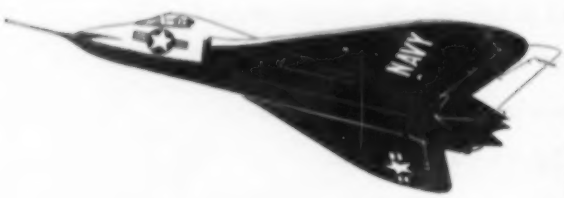
39th COLLIER TROPHY AWARDED FOR TWO J-57-POWERED JET FIGHTERS

The Collier Trophy, America's highest annual award for achievement in aviation, was awarded jointly in mid-December to the men who directed development of America's first two supersonic jet fighters, both of which are powered by Pratt & Whitney Aircraft J-57 turbojet engines and afterburners. Receiving the trophy were J.H. Kindelberger, chairman of the board and chief executive officer of North American Aviation, for the Air Force F-100 Super Sabre, and Edward H. Heinemann, chief engineer of Douglas Aircraft Company's El Segundo Division, for the Navy F4D Skyray.

First U.S. production airplane to fly supersonically in level or climbing flight was the F-100. This plane holds the present official world's speed record of 755.149 miles per hour. Deliveries from North American's production line at Los Angeles began more than a year ago. Today the big fighter is being introduced into operational Air Force units.

The F-100 is 45 feet long, 14 feet high, and has a wing span of 36 feet. The wings and tail are swept back 45 degrees. It has a service ceiling of above 50,000 feet and a combat radius of over 500 nautical miles. Flight tests began in May, 1953, and production deliveries started in October of that year.



Second of the prize-winning pair of supersonic fighters is the Douglas F4D, a single-engine Navy fighter which is expected to be in carrier service this year. It is an interceptor. With its J-57 engine, the production model promises higher all-around performance than the prototype F4D that set a briefly-held world speed record of 753.4 miles per hour in October, 1953.

Like the F-100, the F4D is large for a fighter. It is 50 feet long. Span of its unique, modified delta wing is 33½ feet. The Skyray is now in quantity production in California at Douglas Aircraft Company's El Segundo division.

A year ago, the 38th Collier Trophy was awarded for the development of the Pratt & Whitney Aircraft J-57 turbojet. This 10,000-pound-thrust power plant provides outstanding performance in a number of other U.S. fighters, bombers and one tanker-transport, as well as F-100s and F4Ds.

HAMILTON STANDARD ADVANCES IN THE AIRCRAFT EQUIPMENT FIELD

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Hamilton Standard's propeller activity continues at a high level in spite of the company's growing work with aircraft equipment. Ten different propeller types are being made today for 24 different piston or turboprop-powered aircraft now in production. Included are 15-foot Turbo-Hydromatic propellers for use on a new turboprop military transport.

The last few years have been marked by the continuing expansion of research, test and development facilities at the company's plant in Windsor Locks, Connecticut. These facilities reflect the growing demands imposed on modern aircraft by widely different operating and climatic conditions.

NEW HELICOPTER ALTITUDE RECORD SET BY SIKORSKY

With a flight to 24,500 feet, Sikorsky Aircraft's new XH-39 has established a new altitude record for helicopters. The flight was made at Bridgeport, Connecticut, on October 17. It topped the old mark, set in 1953, by 2390 feet.

Both altitude and speed records are now held by Sikorsky's new utility helicopter, which was built for the U.S. Army. The turbine-powered aircraft whirled to a record speed of 156.005 miles per hour late last summer. Pilot on both flights was the Army's Warrant Officer Billy Wester.

The XH-39 is a spirited performer. It is powered by one Turbomeca Artouste II, a light-weight gas turbine engine developing about 400 horsepower. The engine is being made in the U. S. under license and is known as the Continental T-51. The XH-39, first helicopter to have fully retractable landing gear, is capable of carrying three passengers plus cargo, or a total payload of 800 pounds in the 81-cubic-foot cabin compartment.

The XH-39 is the first Sikorsky helicopter development to be powered by a turbine engine.

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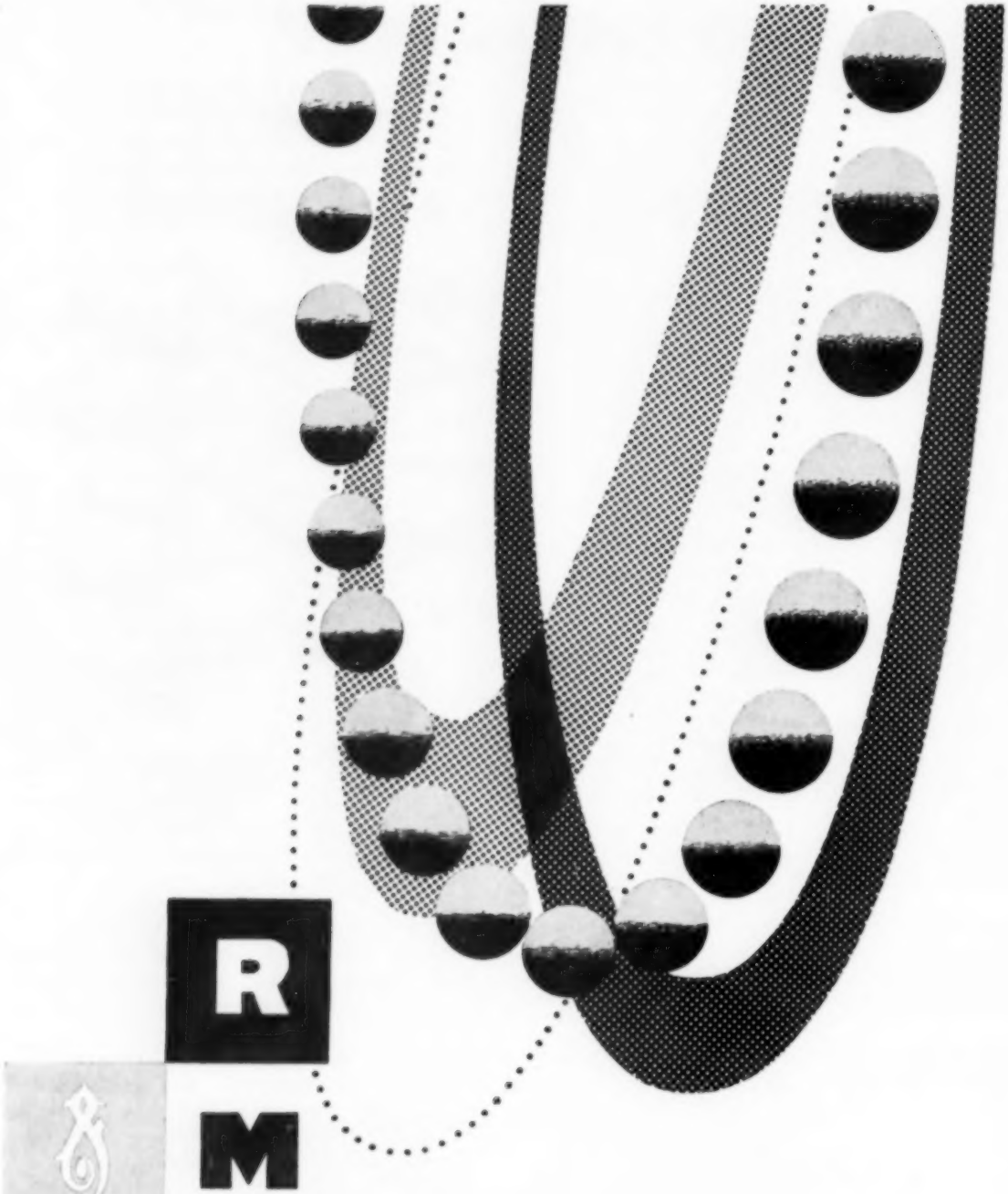

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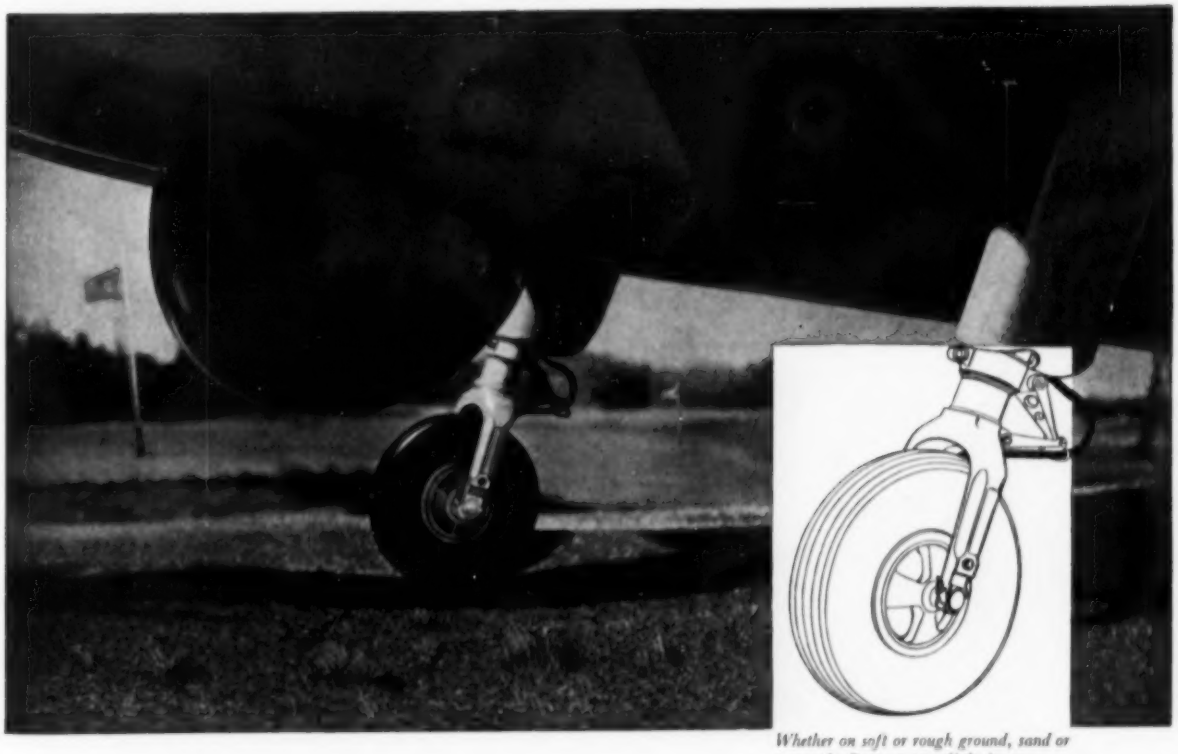

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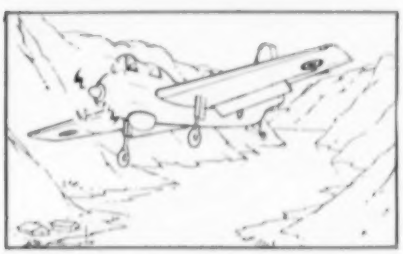

The extremely good handling characteristics of the Seamew combined with simplicity of construction and clear vision make it an excellent aircraft to fly, even for pilots with little experience of this type.

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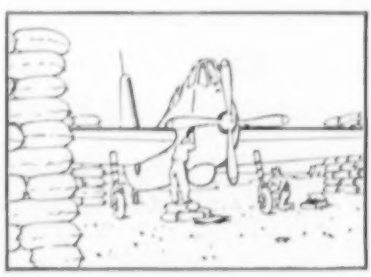

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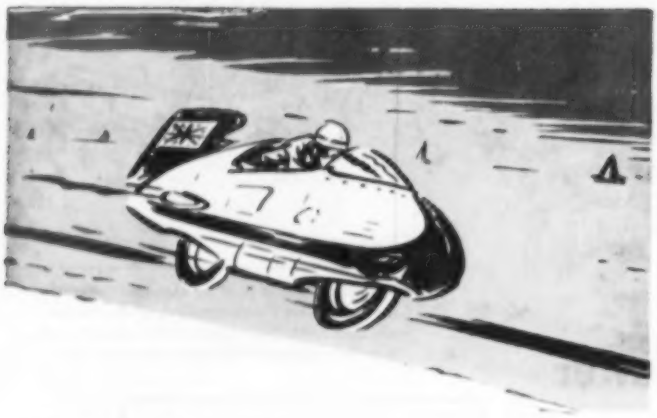

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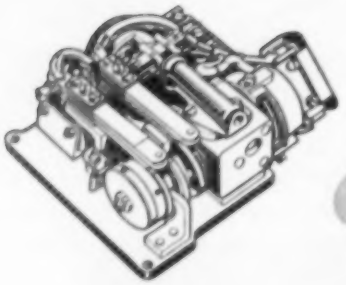

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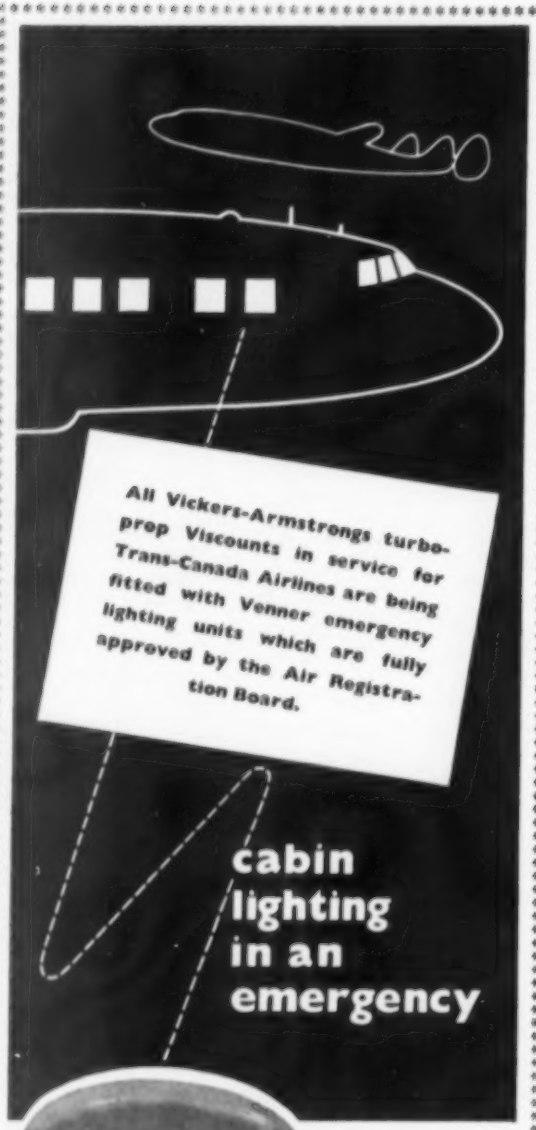

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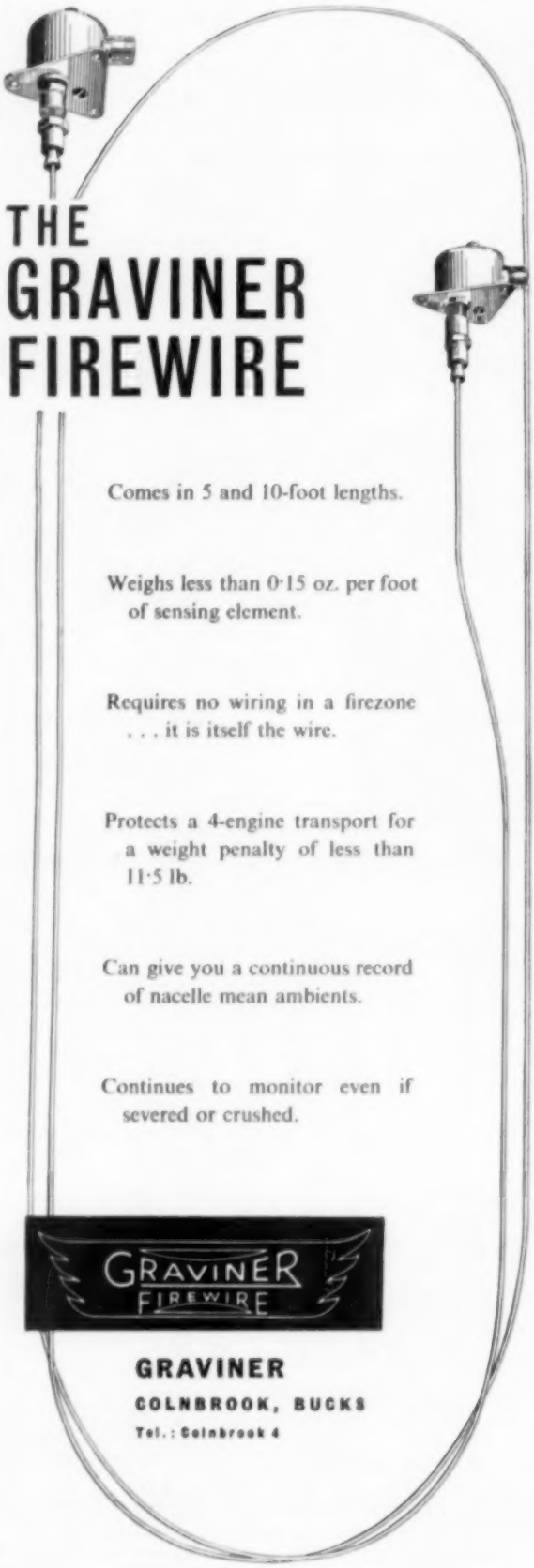

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Lebensraum

PASSENGERS flying into London Airport can now begin to get a good idea of the picture which this immense undertaking will present when completed. Enormous servicing bases for the two Corporations stand out on the south side, countless smaller buildings serve the airlines and contractors, the new central terminal—tunnel-fed and, externally, two-thirds finished—dominates the whole, with its runways and taxi tracks stretching in every direction. Certainly this is an airport of which to be proud; the international airlines are indeed well catered for.

It seems to us that so vast an organization also raises certain dangers. It shows signs of engulfing the whole of London's flying-space. Like a great oak tree, its branches and roots spread wider and wider until everything beneath it is choked or deprived of nourishment. And the "arboriculturists" who are responsible for its planting, growth and welfare seem dazzled by their handiwork, with neither eyes nor ears left for anything else.

London has in fact closed (or failed to maintain) more civil airports in the last few years than have been opened by any other city—some for good reasons, others not so. Whichever it is, the smaller operators and those who, to an increasing extent, fly business aircraft to and from London, will soon be very greatly inconvenienced. Airfields they cannot or may not use any more include Northolt, Heston, Hanworth, Hendon, Hatfield, Brooklands, Redhill, Gravesend, Kenley, Fairlop. According to present planning, the days of Croydon, Bovingdon and Stansted are numbered, and Fairoaks has a doubtful future. The loss of Lympne—replaced, of course, by Ferryfield—is not without importance, particularly to Continental visitors to London.

Thus, in a few years' time the whole of the south side of London may have but one civil airfield within a reasonable distance, namely, Gatwick; and even here there may, it seems, be restrictions upon non-scheduled operators and upon the setting up of servicing organizations displaced from defunct airfields. The flying clubs will be squeezed out and alternative landing grounds for bad weather or emergency almost non-existent.

The Big Three

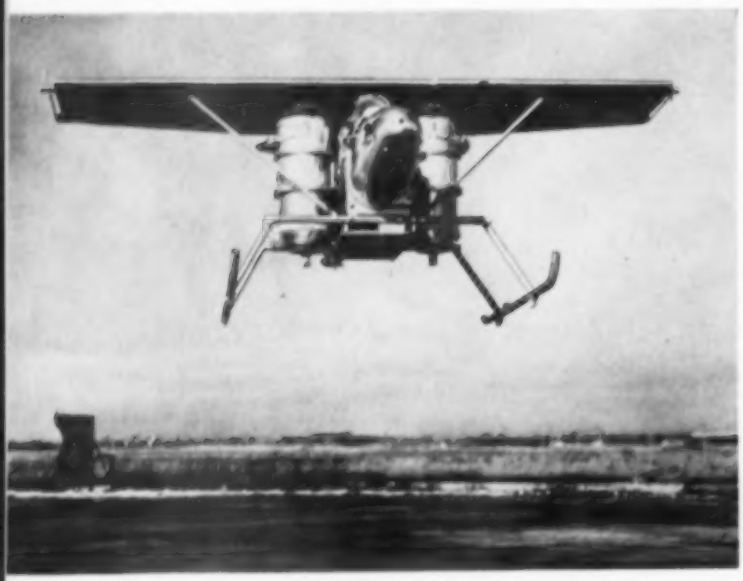
The July 1953, White Paper on London's airports takes into consideration only London Airport, Blackbushe (which is nearly half-way to Southampton) and Gatwick. These three are not sufficient and it is short-sighted to overlook the needs of the smaller operators.

In a few years' time helicopters will also require bases, including hangars, close to London, for they cannot be housed, maintained, or even refuelled at city-centre airstops. In passing, we may also note that, unlike the majority of European capitals, London has no heliport nor even specific plans to build one.

The reason that has sometimes been given for deciding to close airfields is that their traffic interferes with the London Airport pattern. This has been true in some cases—particularly of Northolt; yet, because it was expedient, this was one airfield which until very recently was kept open for commercial operations, and it is still in active military use. In some other cases it is not true; and if, for example, Croydon traffic really upsets London Airport movements, it is time London's pattern was re-examined.

Travellers familiar with United States airlines will notice when they come into London that whereas, over there, a great number of services start with on-track climbs and terminate with straight-in approaches (and many of their airfields are far busier than London), they are often treated here to a sinuous ten-minute tour of Thames-side towns from Putney to Marlow.

We would most seriously recommend that no more of London's civil airfields be closed down until the present and future needs of all operators have been reconsidered. Croydon in particular should not be closed in 1960 as officially proposed. While by no means an ideal field, it is safe, adequate and well equipped for small and medium-sized aircraft, it has many useful permanent buildings, it is quite conveniently situated for the City and—not wholly unimportant—it has deep-rooted traditions, built up since the early days of civil flying.



U.S. JET-LEVITATION: As described on page 186 the Niagara division of the Bell Corporation have revealed their vertical-lift prototype. The machine is shown here hovering about 10ft above the airport adjoining the factory. It forms a unique link between the company's other products—supersonic aircraft and conventional helicopters.

FROM ALL QUARTERS

The Formosan Crisis

LAST week we recorded the sudden increase in tension in the waters off the east coast of China following the expressed intention of the Peking Government to annex the various islands garrisoned by the Nationalists. During the past week the U.S. Seventh Fleet has been active in the Straits of Formosa, and at the time of going to press was engaged in covering the withdrawal of at least 20,000 persons—principally troops—from the Tachens, a group of islands about 200 miles north of Formosa admitted to have been abandoned by Chiang Kai-Shek.

The main striking power of the 7th Fleet is vested in the self-contained carrier task force including *Boxer, Yorktown, Wasp* and *Kearsarge* (all of around 33,000 tons) and the mighty *Midway* (50,000 tons full load) which joined at the beginning of this month. The 500-odd aircraft of the group have been very active in flying combat air patrols and early-warning picket duties. They have orders to shoot if attacked.

On February 6th all civilian traffic of ships and aircraft was diverted from the troubled Straits of Formosa. All flights through Hong Kong to Tokyo by B.O.A.C. and other operators were delayed by over an hour by the new routing to the East of Formosa.

The only case of air-to-air combat reported was a sharp engagement in a completely different theatre. A U.S.A.F. North American RB-45 was on strategic reconnaissance over the Yellow Sea escorted by a flight of Sabres. When about 10 miles off the coast of North Korea and 40 miles west of Pyongyang, the B-45 tail gunner sighted a section of four Mig-15s which "began a firing pass." He returned the fire with his pair of 0.5in guns (radar-directed) and claimed damage to one fighter. Four more Migs then appeared and a dog-fight ensued, the Sabres effectively breaking up the attack on the B-45 and two pilots—Capt. G. F. Williams and Lt. C. D. Salmon—each claiming one Mig as a kill.

EXPRESS DELIVERY of all kinds of freight and military stores is promised by the Lockheed C-130 Hercules, the first air-to-air photograph of which is reproduced here. The Hercules is powered by four Allison 756 turboprops, each of 3,750 e.s.h.p., and was the subject of a lengthy discussion in "Flight" of December 10th, 1954.

New Scientific Adviser to Air Ministry

IT is announced that Mr. Handel Davies, M.Sc., F.R.Ae.S., has been appointed to the post of Scientific Adviser to the Air Ministry. At present serving at the Aeroplane and Armament Experimental Establishment, Boscombe Down, he will take up his new duties on March 1st.

Mr. Handel Davies.

Born in 1912, Handel Davies won a State scholarship from Aberdare Secondary School to the University of Wales, Cardiff, in 1930. There he took first-class honours in mathematics in 1933 and in physics in 1934. He was awarded research scholarships in the subsequent two years, gaining his M.Sc. for research in atomic physics.

Joining the R.A.E., Farnborough, in 1936, he had a well-varied six years' work on engines, stability and control problems and armament, but he was principally concerned with wind tunnels. During the next four years he served in the Ministry of Aircraft Production, and was engaged with new fighter projects and long term planning of Air Staff requirements. On returning to the R.A.E. in 1946 he was placed in charge of high-speed flight research and in 1947 was promoted head of the Flight Section in the Aerodynamics Department. In 1952 he was appointed Chief Superintendent at the A. and A.E.E., Boscombe Down.

In the Commons

THE Hawker Hunter was the subject of questions in the House of Commons last week. They were put by Mr. Woodrow Wyatt (Lab., Aston) who asked when defects in the fighter—causing the engine to stall when the guns were fired—were expected to be cured.

Mr. George Ward, the Under-Secretary for Air, replied that it would be necessary to make certain modifications, which were now being planned, to ensure that in all circumstances the Hunter's guns would not affect the performance of its engine. He stressed his view that, even now, the Hunter was a formidable aircraft and "could go into action tomorrow."

Mr Wyatt was dubious about his assertion. He went on to ask if it was not the case that, as the Hunter could not fight operationally, as the Swift would never do so, and as the Javelin and the P.1 were not yet available, and as there were no guided missiles to replace Anti-aircraft Command, there was no air defence whatsoever of this country.

Mr. Ward repeated that the Hunter was perfectly capable of "going into action tomorrow." It was true that at certain heights and in certain conditions of flight a surge was caused in the engine by the firing of the guns, but that was a matter which could be remedied.

Mr. E. Shinwell (Lab., Easington) asked if it was not true that the reason why the Hunter was equipped with guns was that although originally it was intended that it should use air-to-air missiles they were not available, nor was the equipment satisfactory for the purpose.

Mr. Ward did not comment directly on the suggestion, but said that with its four guns the Hunter was the hardest-hitting aircraft in service.

In earlier exchanges he said the Javelin should be in Squadron service during the coming financial year and that development

MIDGET MYSTERY: A "Flight" impression of the Marcel Dassault Mystère XXVI (Bristol Orpheus), a design submitted for the NATO light fighter/attack competition. Measuring only 25ft 4in in span, the little machine seems to owe something to both the Supermarine Swift and the U.S. Navy's Douglas Skyhawk attack bomber.

of the P.1 was proceeding satisfactorily, although no date could yet be given of its coming into service.

He spoke of very favourable handling reports on the D.H. 110 and, for the benefit of the apparently unenlightened, explained that the selection of this aircraft by the Royal Navy was governed by the fact that the Javelin, which the R.A.F. considered capable of greater development, would have been too heavy for naval work.

Guided missiles were also the subject of questions last week. That production orders had in fact been placed for air-to-air missiles of British design was mentioned by Mr. George Ward, who regretted that he could not reveal details of our programme.

Some heated comments were projected in the Under-Secretary's direction when, in replying to the suggestion that the present state of preparedness reflected gravely on the Government, he asserted that any grave reflections to be made should rest with the late Government for not having started work earlier. Despite further interventions, he declined to give an estimate of the date when British air-to-air missiles would be put into service. "I would much sooner be shot at across the Floor of the House," he said "than be guilty of a breach of security."

Security itself was a subject of other Parliamentary questions last week, when Mr. Frank Beswick (Lab., Uxbridge) asked to what extent official approval was given to the service information published in the *Royal Air Force Flying Review*.

Mr. George Ward replied that the review was a commercial publication produced with the co-operation of the Air Ministry. Provided security requirements were satisfied, there was no liability on the publisher to submit articles before publication.

On Wednesday a question was to be asked about changes in Valiant wings and ailerons.

Joining the Board at Belfast

APPOINTED chief engineer of Short Bros. and Harland, Ltd., in April last year, Mr. H. G. Conway, M.A., F.R.Ae.S., M.I.Mech.E., has been appointed a director. Born in Vancouver, B.C., and educated in this country, Mr. Conway has had varied experience in the industry. From 1938 to 1945 he was chief engineer to Aircraft Equipment, Ltd., and in 1945-47 was with the Dunlop Aviation Division. After that, until he joined Short Bros., he was technical director of British Messier, Ltd.

Mr. H. G. Conway.

U.S. Production

THE aircraft industry of the United States is now producing 91 different types of aircraft, exclusive of pilotless machines. This is revealed in a survey conducted by the U.S. Aircraft Industries Association, which shows that 28 airframe manufacturers have a total of 65 military aircraft in production, ranging from light liaison types to supersonic bombers. Twenty-six civil types are in production and nine models of helicopter are being quantity-produced for military use; another six are available for the civil market. The survey attaches due importance to the fact that America is now building more jet engines than piston engines.

Stockholm Decca Chain

THE Royal Swedish Navy announced this week that an order has been placed with Decca Navigator och Radar A.B. for a Decca Navigator chain to be erected in the neighbourhood of Stockholm. The chain will cover a large part of the Baltic Sea from the island of Oland in the south to Aland in the north and also part of the Aland Sea, the Bay of Gävle and the Gulf of Bothnia. This Baltic chain will join up with the Danish chain already in operation.

The system consists of four transmitting stations, the whole cost of which is about three million Swedish Kröner (£200,000). Delivery is expected to take place before the end of this year, and therefore the chain can be in full operation in 1956. The stations will be operated by a company now being formed for the purpose.

Decca Navigator receivers for the ships will be hired out by Decca Navigator och Radar A.B., which has offices and service depôts in Stockholm and Gothenburg.

The chain will be also of great importance for air traffic. British European Airways are now using the Decca system—together with the Flight Log—in their Viscounts, and it seems likely that Scandinavian Airlines System will show increasing interest now that the Stockholm area will come into the Decca coverage. For helicopters, Decca is the only practicable navigational aid, and the new chain will be of importance for the air/sea rescue organization.

The Swedish Hydrographer's office, which purchased a small Decca chain in 1946, will be responsible for the sea charts which will be available through normal chart suppliers.

Rocket Review

YESTERDAY, a Royal Aeronautical Society main lecture was being read before the Isle of Wright branch of the society by Prof. A. D. Baxter, M.Eng., F.R.Ae.S., M.I.Mech.E., F.Inst.Pet., professor of aircraft propulsion at the College of Aeronautics, Cranfield.

He chose as his subject *The Prospects and Problems of Rocket Propulsion for Aircraft*. Unfortunately anyone who attempts to present an up-to-date appraisal of this field is hamstrung by security measures, and Prof. Baxter was unable to describe any of the rocket motors at present in production or under development in this country or America. He had, however, collected together a great deal of material on propellants, control systems, mechanical design and flight performance, and his paper will be abstracted *in extenso* in an early issue.

L. J. Brain for D.H. Australia Board

AN important appointment in one of its overseas companies is announced by the de Havilland enterprise: Mr. Lester J. Brain, who has been chief executive of Trans-Australia Airlines since their formation in 1946, has accepted the position of managing director of de Havilland Aircraft Pty., Ltd., of Australia. He will begin his new duties at Bankstown, Sydney, on March 17th, filling the position vacated at the end of 1953 by Maj. Murray Jones—who, however, continues as chairman of the Board. Mr. Lester Brain is one of Australia's best known aviation personalities, having served for 22 years with Qantas as a pilot and as operations manager before his appointment as general manager of the Government airline undertaking when it was formed after the war. De Havilland products will be old friends to him, for of the 10,000 hours that he flew with Qantas more than 6,000 were on D.H. aircraft; he flew the first D.H. 86 (VH-USC) from Hatfield to Brisbane in October 1934. Mr. Brain's colleagues on the Board of the Australian de Havilland company are (in addition to the chairman) Mr. D. H. McLachlan, director and general manager; Mr. L. J. Byrne, director; and Mr. R. J. Vicars, director. There is one English director, Sir Geoffrey de Havilland.

Mr. Lester Brain.

***Destination Woodford:** An Olympus 101 being crated at Filton for eventual installation in an Avro Vulcan bomber.*

ABODE of the GODS

Seeing is Believing at Bristol's Engine Division

THE 150-hr type-test of the Olympus 101 two-spool turbojet, announced in *Flight* last week, afforded a welcome opportunity to visit the engine division of the Bristol Aeroplane Company at Filton; and the occasion was one on which we could thoroughly re-acquaint ourselves with the whole range of Bristol engine developments, many and varied as they are. If there was any failure in this intention the fault lay not with Air Chief Marshal Sir Alec Coryton, managing director of the division, or Dr. S. G. Hooker, the chief engineer, or with Dr. R. C. Plumb, the assistant chief engineer, but with human powers of rapid assimilation.

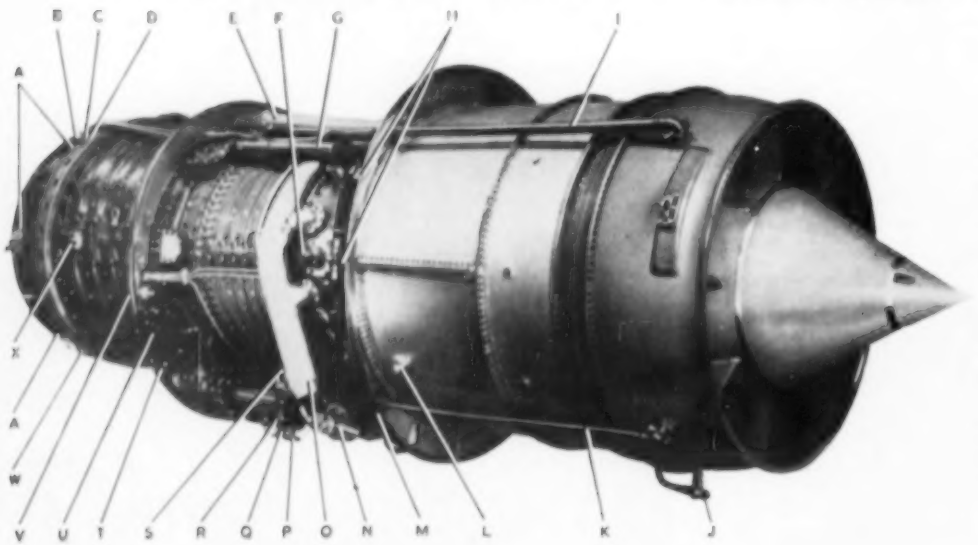
Fittingly, we paid our homage first at the soundproofed temple of Olympus, where Dr. Hooker reminded us what manner of engine the "101" is by pushing the power lever unceremoniously forward and sending the thrust indicator zipping round to a pin-point 11,000 lb. And just what double this thrust will do for a Canberra B.2 was later demonstrated for us by test pilot Walter Gibb. In terms of angle, speed and duration of climb, and in Gibb's cavalier handling of the power levers, one judged this performance to surpass any of the memorable shows by the same aircraft at Farnborough last year. Always a terrific performer, the Canberra with Olympus 101s is nothing short of sensational; and let it not be forgotten, in these days of setbacks and sorrows, that this same Canberra, with earlier Olympuses, achieved the world's altitude record of 63,668ft as long ago as May 4th, 1953, and that this *British* record looks like standing for some time to come.

It is, of course, natural to hope that with the thrust ratings now being registered on Olympus test beds (for the 101 will have far more potent successors, among them, perhaps, the Olympus BO1.6) the mark may yet be placed further above the reach of the foreigner. Natural laws, however, demand very great increments of thrust for the achievement of the extra 2,600 (4 per cent increase) feet necessary to set a new world altitude record.

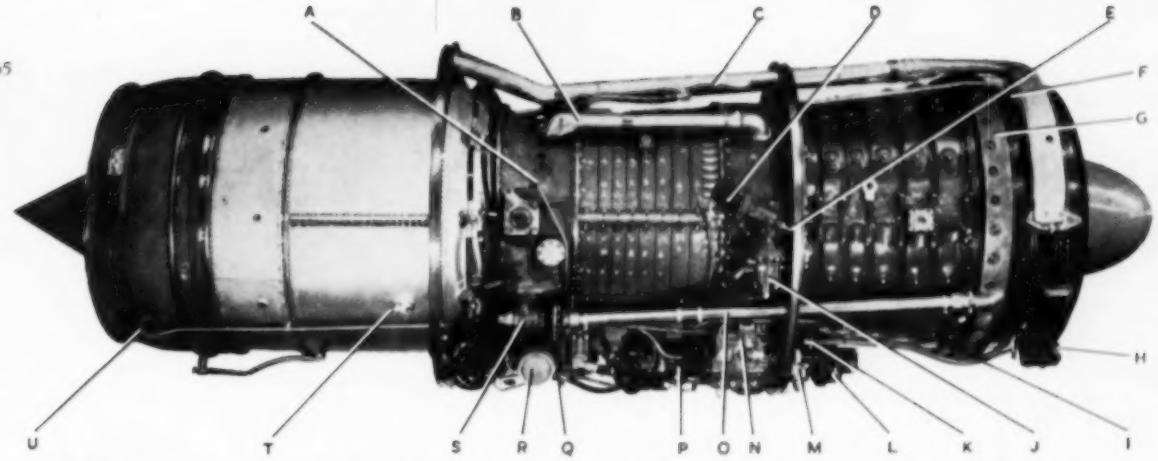
In its ability to maintain thrust at height the Olympus certainly appears to be unmatched by its contemporaries, and Bristols take sober pride that, although, in record-breaking trim, the Olympus-Canberra was some 4,000 lb heavier than an opposite number with two single-shaft turbojets of another make, its ceiling proved to be 3,000ft higher. As Dr. Hooker says, the extra weight really pays off at altitude.

Certainly the Olympus 101 is a hefty piece of hardware, for it turns the scales at 3,650 lb; but further mitigating this weight is the extremely low specific fuel consumption of 0.75 lb/hr/lb for a thrust of 8,000 lb, or 0.79 for 11,000 lb, which has enabled the company to claim a lower "specific" than has been recorded for any type-tested turbojet extant. A weighty matter indeed, this, when it is reckoned that a typical bomber with a fuel load of 60,000-70,000 lb might, by virtue of Olympus power, carry a military load three tons greater over a given range.

This remarkable economy stems principally from the high compression ratio, and, in turn, this can be attributed to the two-spool principle, to which some of the world's greatest engine-makers are now increasingly committed (Bristol and Rolls-Royce in this country, and Pratt and Whitney and Wright in America). And far from incurring an undue weight penalty, the two-spool formula, in Dr. Hooker's opinion, will ultimately result in a lighter engine, for, as he points out, with a two-spool engine it is possible



(A) Outlets for nose fairings and intake vane de-icing air.
(B) Main oil return pipe.
(C) Intake ram pressure pipe to full-range flow control.
(D) Oil tank vent.
(E) Generator cooling-air exit duct.
(F) Main mounting trunnion.
(G) Air supply to delivery casing.
(H) Burners.
(I) Air feed pipe to No. 8 bearing labyrinth.
(J) Combustion-chamber drain.
(K) No. 8 bearing return oil.
(L) Igniter plug.
(M) Fuel-flow distributor.
(N) Oil cooler.
(O) Engine breather.
(P) Fuel dump-valve.
(Q) Fuel-system drain.
(R) Low-pressure fuel filter.
(S) Hot-air valve.
(T) Hydraulic pump.
(U) Starter.
(V) Fuel inlet pressure warning light switch.
(W) No. 1 bearing oil return pipe.
(X) Front mounting trunnion.



(A) Oil feed to Nos. 4, 5, 6 and 7 bearings.
(B) Intermediate gear-case breather.
(C) Generator cooling-air outlet duct, showing inducer pipe.
(D) Low-pressure compressor r.p.m. tachometer generator.
(E) Hand-turning connection for low-pressure compressor.
(F) Air feed to No. 1 bearing labyrinth.
(G) Annulus for intake guide-vane de-icing air.
(H) Junction box for generator cables.
(I) Main oil feed pipe tank/pump.
(J) Low-pressure compressor overspeed governor.
(K) Oil feed to No. 1 bearing.
(L) Hydraulic pump.
(M) Oil tank filler connection.
(N) Oil pump relief valve.
(O) Duct for intake guide-vane de-icing.
(P) High-pressure compressor tachometer generator.
(Q) Air/fuel ratio control.
(R) Fuel-cooled oil cooler.
(S) Hot-air valve and actuator for intake guide-vane and nose fairing de-icing.
(T) Igniter plug.
(U) Oil return from No. 8 bearing.

to achieve with 12 compressor stages results which, in the single-spool, would require 15 to 16. Thus, the engine can be made shorter, and, in the long run, lighter.

It is fascinating to observe on the test bed the speed relationships between the two compressors of the Olympus. At low speeds the ratio is about 2 : 1, the low-pressure compressor turning at 2,500 r.p.m. and the high-pressure at 5,000 r.p.m.; but the ratio progressively adjusts itself so that the maximum thrust figures, respectively, are 6,500 and 8,500 r.p.m. Dr. Hooker mentioned that at minimum self-sustaining speed a mere 10 lb of thrust is generated, though it is not possible to accelerate away from this speed. Continuous cruise output is 9,600 lb, and the engine can be accelerated from idling to its full take-off thrust of 11,000 lb in 5 seconds.

High thrust, fuel economy and acceleration are qualities fervently to be desired in a long-range all-weather fighter, and it would come as no surprise if the Olympus were to find a very important application in a machine of that class. Questioned on the susceptibility of the two-spool layout to supersonic conditions, Dr. Hooker said that it was suitable for operation over a wide range of intake conditions, though for supersonic flight relatively low compression ratios would have to be used. The engine has been cleared to use wide-cut gasoline or kerosine.

Among the graphs exhibited to illustrate Olympus performance was one showing power curves at the beginning of a test run and at a late stage, when dirt had been deposited on the blades from the atmosphere, to the obvious detriment of performance. Once an engine has been washed through with paraffin and water, however (this is done at idling speed), thrust is quite restored.

We saw the first batch of Olympus 101s going through for Avro Vulcans, in company with Proteus 705s for B.O.A.C. Britannias, and were told that the works are tooled for sixteen Proteus engines a month, to be produced as and when required. This figure, of course, is by no means representative of Bristol's total capacity. Orders are being invited from abroad and may, indeed, be forthcoming, for in its class the type-tested and fully approved Proteus is assuredly a better engine than any other now in production.

In one sense the company's retention of the name Proteus was unfortunate, for the 705 was completely redesigned from the original Proteus engine as long ago as 1949. But if, as is confidently predicted, the Proteus 755-powered Britannia 300LR will, in the autumn of 1956, outclass the Douglas DC-7C or any other comparable transport, then it might well be asked, what's in a name?

Specific fuel consumption of the Proteus at 400 m.p.h. and 30,000ft is 0.464 lb/hr/e.h.p.—a figure checked during flights up to 35,000ft on the Britannia and Proteus-Ambassador. No overhaul period has yet been specified, but Bristols will undertake to supply B.O.A.C. with engines at a fixed fee per flying hour.

Meanwhile, work on the new BE.25 turboprop goes ahead, and we were assured that when the time comes for a Britannia operator to fit this "supercharged" two-spool unit in place of the Proteus (should this measure suit his particular needs), the change could be effected in two weeks. Though the full cruising output of the BE.25 could not be fully utilized by the present Britannia airframe (the cruising Mach limitation is 0.65 or 415 m.p.h.), Bristols contemplate progressive modification for higher speeds.

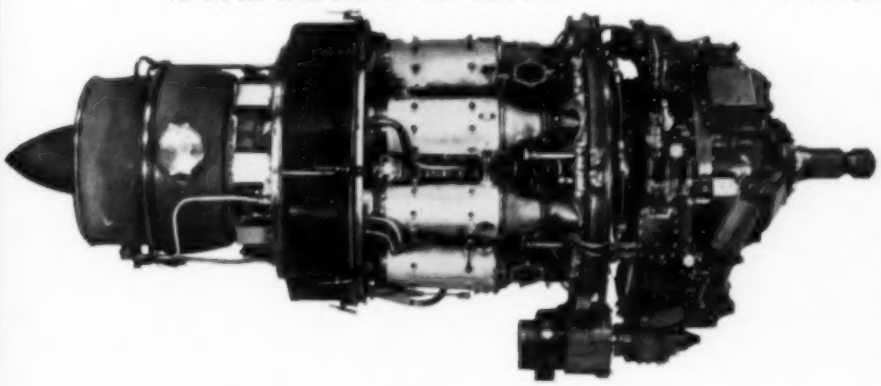
The ability of the BE.25 to spare air from its compressors without impairing cruising performance below its "rated" altitude of about 25,000ft may prove in the future to be a most important feature. Already it is planned to tap the main compressors for all cabin air, thus eliminating separate blowers and bulky heat exchangers. In addition, hot air can be spared for de-icing and for other services driven, perhaps, by air turbines.

One gathered that whereas the Lockheed L-1449 Super Constellation, as described in *Flight* of January 14th, could readily utilize the new power plant, the DC-7 is unsuitable for either the BE.25 or the Proteus.

A weight-saving of 500 lb per power plant is in prospect for the BE.25 Britannia; and with titanium used for fire-walls, shrouds and other items at present fabricated from stainless steel, the airframe itself should come out some 600 lb to the good. A set of experimental titanium components is now being made up for a Britannia 100, and bench and flight tests should be under way before the end of the year. "Flap blowing" is a further development foreseen for the BE.25-powered machine.

Only in not seeing the Orpheus were we disappointed in our visit to Filton; but the progress report was excellent. More than one engine has been run (to a total of 70 hr by last Tuesday week), and Bristols look forward with confidence to a 150-hr type-test. Aerodynamically the Orpheus compressor is the low-pressure unit of the BE.25, but with aluminium, instead of steel, blades. Thrust rating at 20,000ft is 4,000 lb. And as nine out of ten projects to the NATO fighter/attack specification specify the Orpheus, and as numerous additional applications are foreseen in this country and abroad, the prospect for this golden boy of the Bristol gods seems fair indeed. H.F.K.

For the 300 Series Britannia—the Proteus 755.



HERE AND THERE

SUPER MIG: This impression of Russia's Mig-17 fighter is based on official U.S. Navy information and differs in detail from that in our previous issue. Note especially the wing-form. Complete accuracy at this stage cannot be guaranteed.

Royal Inauguration for L.A.P.

IT is announced that the new terminal building and facilities at London Airport are to be formally inaugurated by Her Majesty the Queen on December 16th.

The F-100 Grounding

THE three-month ban on the flying of the North American F-100 Super Sabres is reported to have been lifted, "following modifications which include the fitting of a new vertical tail." This, if confirmed, is of particular interest in that the first major modification made to the F-100 after early flights was reduction in rudder size.

Production Vulcan ?

AN Avro Vulcan, serial-numbered XA889 and having a silver finish (except that the lower "mandible"—presumably housing radar—was black), was seen flying from Woodford on February 4th. Although the makers have nothing to say on the matter, it may confidently be assumed that XA889 is the first production Vulcan, the two prototypes being numbered VX770 and VX777 and finished wholly in white.

Brancker Memorial Lecture

ON Monday next, February 14th, the 1955 Brancker Memorial Lecture of the Institute of Transport is to be delivered by Sir Arnold Hall, F.R.S., M.A., F.R.Ae.S., Director of the R.A.E. His subject will be *The Influence on Civil Aviation of Some Current Researches*. The meeting, which will take place at 5.45 p.m. in the Jarvis Hall, 66 Portland Place, London, W.1, will be open to visitors, without ticket.

Pilot and Doctor Honoured

PILOT at one time or another of almost every type of aircraft used in American high-speed flight research, Scott Crossfield of Edwards A.F.B. received the Lawrence Sperry Award for 1954, presented at the honours night dinner of the Institute of Aeronautical Sciences. The award recognizes his "important contributions in aeronautical flight research especially at transonic and supersonic speeds up to Mach 2." Presented on the same occasion was the John Jeffries Award, this year's recipient being James P. Henry, M.D., for "outstanding contributions to the advancement of aeronautics through medical research." Dr. Henry, who is chief of the acceleration unit of the Aero Medical Laboratory at Wright Air Development Center, did valuable work in the development of the partial-pressure altitude suit.

G. de Havilland Trophy Awarded

THE Royal Aero Club announced last Monday the award of the Geoffrey de Havilland trophy for 1954 to Lt. J. R. S. Overbury, R.N., in recognition of his London - Amsterdam point-to-point record on July 29th last, when, flying a Hawker Sea Hawk, he made the journey at 571.5 m.p.h. The trophy is awarded to the British pilot making the best speed in an official record attempt or race during the year.

Firefly Tugs for India

ON the morning of February 5th the first of a batch of converted Firefly 1s, ordered for target-towing duties by the Indian Navy, left the Fairey base at Hamble on its delivery flight. Firefly tugs have already been supplied to the Royal Navy, Sweden, Denmark and Holland.

P. and W. Wrights

IN no field of aeronautical activity has rivalry been keener than between the two great American producers of air-cooled engines, Wright and Pratt and Whitney. But such is the pattern of international developments that the Canadian Pratt and Whitney company is now preparing to build Wright R-1820 Cyclone engines for installation in de Havilland Canada-built Grumman CS2F-1 anti-submarine aircraft. Initial contracts cover a hundred machines. The version of the Cyclone selected is the R-1820-82.

Radar Airfield

PERSHORE AIRFIELD, Worcestershire, which was completed during the war, is to be used by the M.o.S. Radar Research Establishment, Malvern, for flying operations in connection with radar development. One runway is to be extended by about 500 yards.

A Boeing Birthday

CONGRATULATIONS to *Boeing Magazine* (editor, Jim Douglas) on celebrating its 25th year of publication. In the birthday issue the first editor, Harold Crary—who recently retired from the post of vice-president (sales), United Air Lines—recalls the earlier days.

Sales Talk

THREE weeks ago the Jordan Government announced that it intended to develop an air arm and was approaching Great Britain with a view to securing aircraft. Last week Jordan Radio reported that the Italian Minister in Amman had informed Jordan's Defence Minister that Italy was in a position to supply all the aircraft needed. The Italian offer, said the report, was being studied.

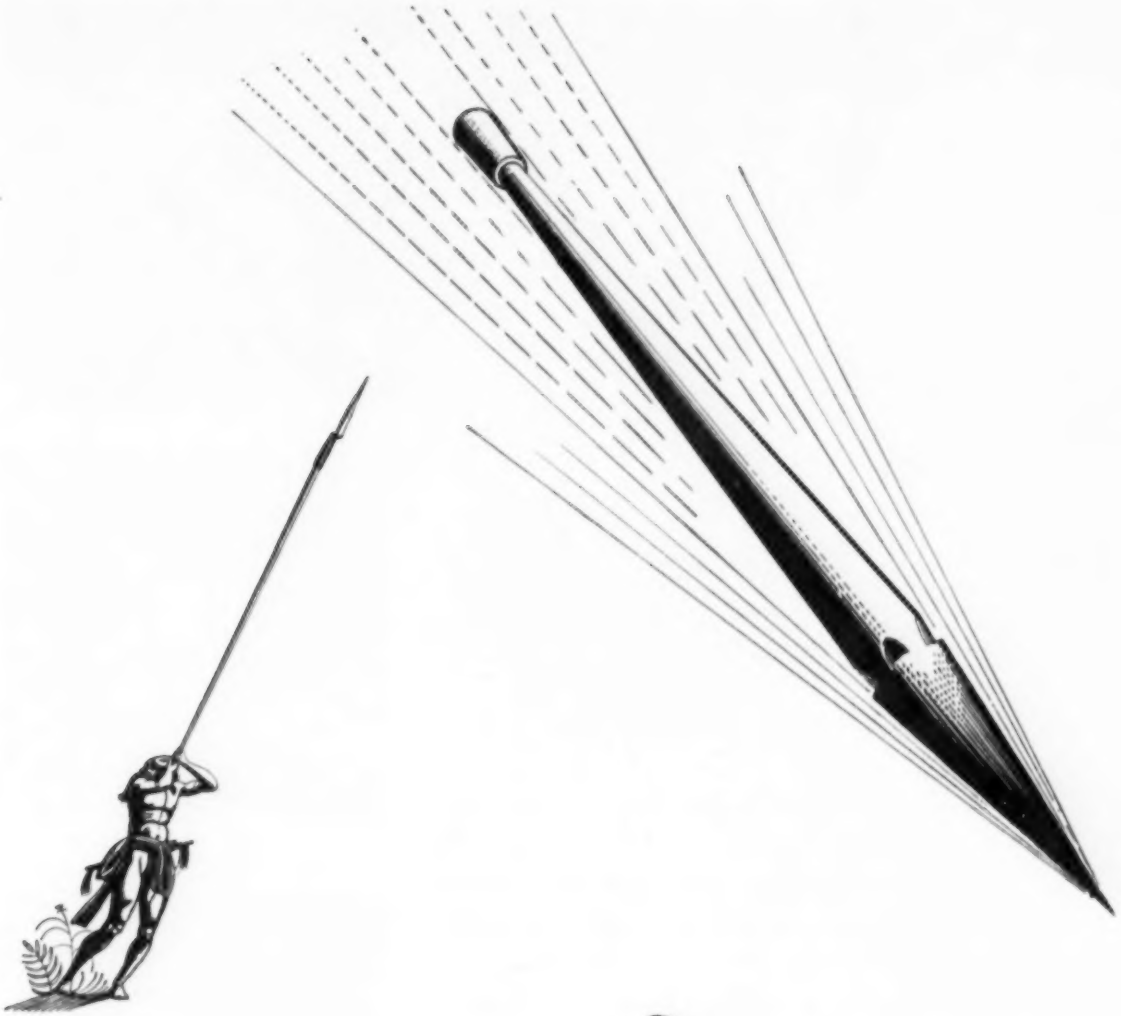
A Helicopter in N.Z.

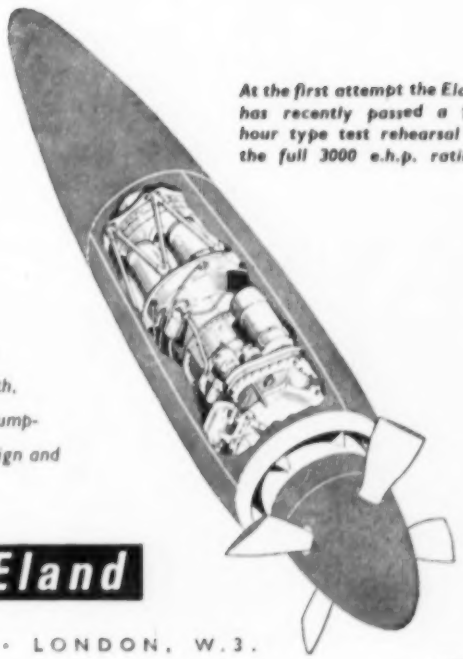
NEW ZEALANDERS are soon to have their first sight of a helicopter in operation. Mr. O. G. James, of Helicopter Services, Ltd., Hamilton, has secured Government permission to use a Hiller 12B for general commercial work, including crop-spraying, publicity, and charter flying. Mike Meager, a Hiller test pilot, will spend some weeks in New Zealand instructing the new owners in helicopter operation.

Italian Loss

DUE to be flown from Florence to New York by Maner Lualdi, the new Nardi FN.333 amphibian has been destroyed in an accident during a makers' test flight. Maj. Nello Valzania, one of the most experienced Italian test pilots, was carrying out stalling trials when the aircraft entered a spin from which it did not recover. At the time of going to press it is not known whether Maj. Valzania escaped. It was he who broke the world 1,000 km closed circuit record for aircraft under 500 kg with the Rondone F.4 last December.

LORD BRABAZON, who was flying aeroplanes in 1909 and was 71 last Tuesday, with the "skeleton" on which, a fortnight ago, he won the Cresta Run Coronation Cup. He covered the course at an average speed of 44 m.p.h.—implying some 80 m.p.h. on the faster stretches.





At the first attempt the Eland has recently passed a 150 hour type test rehearsal at the full 3000 e.h.p. rating.

HIGH AERODYNAMIC EFFICIENCY

The Eland is an aero-engine giving high power at low cost. It is a single-shaft propeller-turbine developing 3,000 e.h.p. at take-off, with a diameter of only 36 inches. This compactness makes for high aerodynamic efficiency. Other notable features include smooth, surge-free acceleration, low specific weight and low fuel consumption. All in all, the Eland is an impressive example of design and manufacture at the service of commercial aviation.

NAPIER Eland

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INTEGRATED FLIGHT SYSTEM

Collins Two-Instrument System for Radio Navigation and I.L.S. Approach

THE use of I.L.S. cross-pointers and visual radio-bearing indicators for instrument approaches and navigation has tended to complicate the task of instrument flying by increasing the numbers of dials to be watched. The indicators on these additional dials, furthermore, require interpretation by the pilot and call for added concentration which, often, he is ill able to afford. One remedy has been to develop instruments, operated by computed signals from several sources, that give the pilot visual instructions as to how to fly his aircraft to take up and maintain a selected flight path, whether this be along a radio beam or simply a certain path through the air. But many pilots prefer a combination of instructional and informative instruments, that is, they want to be told how to fly, while also being kept informed of their attitude and position.

An excellent example of the plain instructional instrument is the Sperry Zero Reader (described in *Flight* on April 2nd last year), while a method which provides both instruction and information for radio beacon navigation and I.L.S. beam-approach flying is the Collins Integrated Flight System, the subject of the present article.

The Collins installation is produced by the Collins Radio Company of Cedar Rapids, Iowa, and is used by Panagra among others. The American Sperry Gyroscope Company has also produced its own integrated instrument system, which has been taken up by Pan American World Airways.

Based on two instruments, called the course indicator and the approach horizon, the Collins Integrated Flight System is intended to provide a means of semi-pictorial *en route* radio navigation, and also a complete presentation of all the information necessary to make an accurate and smooth I.L.S. approach. It was developed in an effort to reduce the number of instruments which a pilot now has to watch, both while flying a given course and while making an instrument approach. In I.F.R. conditions, for example, apart from flying the aircraft on the usual six instruments, he may be trying to listen to an aural range signal, use his R/T. and watch one or more radio direction indicators. And on an instrument approach he will have to co-ordinate his flight instruments, the I.L.S. indicator—in all its jerky and wayward indications—and his engine and utilities indicators.

The Collins system gives him all his steering and attitude information on two dials in such a way that, to quote the company's brochures, he can feel that he is following a white line marked on the ground. Instrument indications, particularly those of the steering needle, are given to him as control-movement instructions rather than, as in conventional flight instruments, position-error indications.

Apart from the two panel instruments the system consists of a remote vertical gyro, a gyro monitor (with small instrument-panel indicator), the steering computor, and its shock-resistant mounting. Besides this, the system requires a gyro-stabilized magnetic compass, a navigational receiver for V.O.R. and I.L.S. localizer, a glide-slope receiver and a marker-beacon receiver, all part of normal aircraft equipment and produced by Collins (among others) except for the gyro-magnetic compass.

BY reason of their clarity in such a context, certain American navigational terms are used throughout this description of a new pilot-aid. Thus "heading" (in England, "course") refers to the direction in which the aircraft is pointed in relation to magnetic north; and "course" (in England, "track") is the path followed, whether in relation to a radio reference or visually over the ground.

The Integrated Flight System has appeared in four versions, FD-101 to 104, which differ from one another mainly in constructional details. An exception is the FD-104, which is designed to be coupled with the Collins AP-101 autopilot for automatic I.L.S. approaches. The lightest of the systems is the FD-103, the total weight of whose four basic elements is 27.9 lb. The power supply required is 27.5 v D.C., 115 v 400 c.p.s. and 26 v 400 c.p.s. Power consumption under operating conditions is 63 VA.

There are two main instruments on the panel and one small indicator, the gyro monitor. This shows by the movement of a needle whether the remote vertical gyro is fully erected and functioning properly. (The necessity for it is not universally accepted.) The course indicator (a 5-in dial in the FD-101 and 102 and a 3-in dial in the FD-103) is a directional reference functioning as a compass repeater. In addition it supplies properly orientated heading information and shows displacement in relation to a V.O.R. radial or an I.L.S. beam. All markings are fluorescent yellow on a black background.

The azimuth ring of the course indicator repeats the indication of the aircraft gyro-magnetic compass, and the miniature aircraft in the centre of the dial and the lubber line in the "12 o'clock" position (both engraved on the instrument glass) show the aircraft heading at all times.

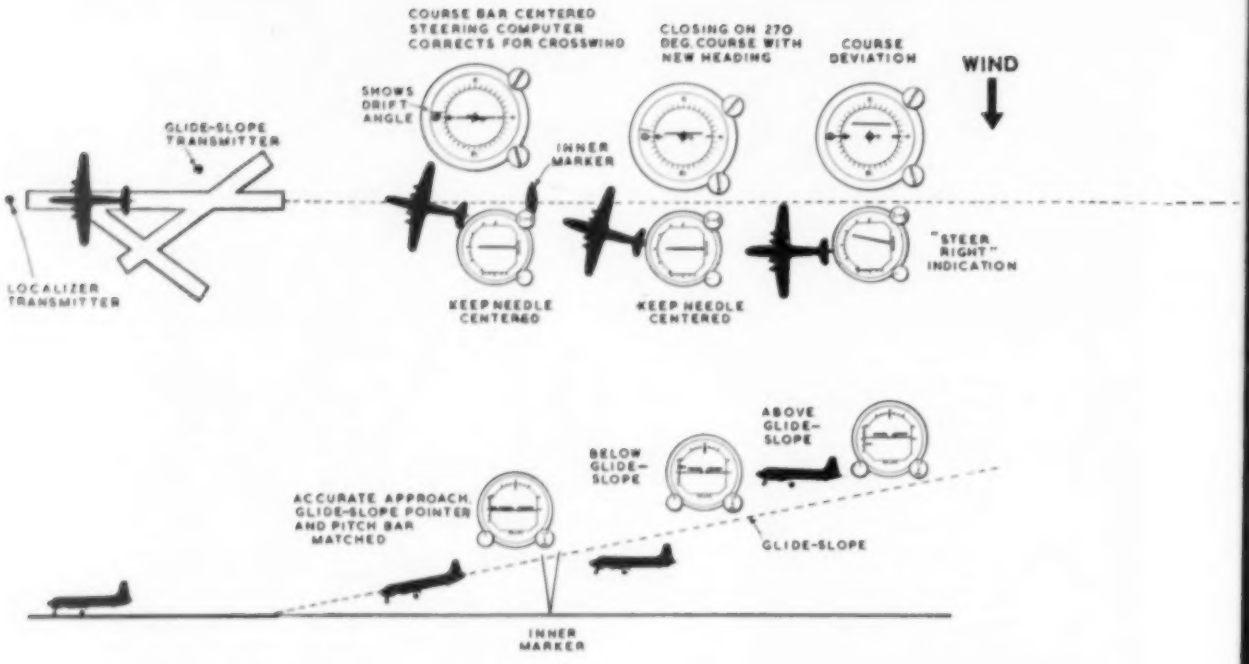
The Course Indicator. The following description refers to the accompanying diagram. The course arrow (1) is set to the desired omni-range or localizer course by turning the course selector knob. The course bar (2) and the instrument-glass miniature aircraft (3) serve with the course arrow to show the aircraft position and heading relative to the selected course. As the selected course is approached on a convergent heading, the course bar will gradually move into line with the course arrow. The short arrow (4) is the beacon "to-from" indicator.

Thus, if a pilot wishes to take a bearing on an omni station, he tunes the receiver to it and rotates the course arrow until the course bar lines up with it. Noting the position of the to-from arrow, he can read a magnetic bearing to the station. The heading marker (5) can be set to a desired magnetic heading by turning the heading selector knob. It thereafter rotates with the azimuth ring. With the correct setting on the approach horizon (described below) it is then possible to hold the selected heading by following the indications of the steering needle.

The Approach Horizon. Basically, this instrument instructs the pilot how to fly in order to turn smoothly onto a radio or magnetic heading or to hold such a heading, while keeping him informed of his attitude. As shown in the accompanying diagram,

(Left) The course indicator, showing (1) course arrow; (2) course bar; (3) miniature aircraft; (4) "to-from" pointer; (5) heading marker; and (6) lubber line.

(Right) The approach horizon, with (1) steering needle; (2) "I.L.S./Heading" selector knob; (3) horizon bar, connected to (4) bank needle; (5) pitch bar; (6) pitch-trim adjustment knob; and (7) glide-slope pointer. Arranged for clarity, the indications shown do not correspond to an actual flight condition. The "LOC" and "G.S." flags appear from under the bank scale at the top of the dial to denote failure of these two functions and also during en route navigation when "HDG" is selected.



This chart of a hypothetical I.L.S. approach to a localizer beam bearing 270 deg shows the instrument reactions during en route navigation and final approach. It has been assumed that the pilot wishes to approach the V.O.R. beacon along the 250 deg radial bearing.

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steering instructions are provided by the steering needle (1) (painted fluorescent yellow) which can be used either while holding a heading during normal flying or for holding the I.L.S. localizer beam on the approach. In the first case, the I.L.S./HDG switch (2) is set to HDG and in the second it is set to I.L.S. In the latter case, automatic correction is made for cross-wind effect.

The horizon bar (3) and the bank pointer (4), both painted fluorescent yellow, together indicate lateral attitude in the same way as does a conventional artificial horizon. The pitch bar (5) (again fluorescent yellow), symbolizing the wings and fin of the aircraft, gives pitch-attitude information, again in the same way as the artificial horizon. The rotation of the pitch trim knob (6) lowers or raises the pitch bar so that a required pitch attitude can be "zeroed" on the horizon bar to make attitude holding easier during an instrument approach. Finally, the glide-slope pointer (7) (painted fluorescent green) moves up and down the vertical scale (coloured red and green) to indicate the aircraft's position—by the pitch bar—relative to the guide-slope.

Method of Operation. The makers recommend that the Integrated Flight System instruments should be centrally positioned in the normal blind-flying panel, with I.L.S. marker and airways fan-marker lights, clock and gyro monitor indicator close by. Before take-off, it is possible to perform a complete pre-flight check on both approach horizon and course indicator, making use either of V.O.R. and I.L.S. facilities in the immediate area of the airfield, or otherwise of external signal-generating equipment. The checks are quite simple to perform and provide a positive indication of satisfactory functioning. The use of the system for *en route* navigation is here divided between the holding of compass headings, the use of omni-courses and the taking of V.O.R. fixes. In practice, however, the three functions can be used almost simultaneously.

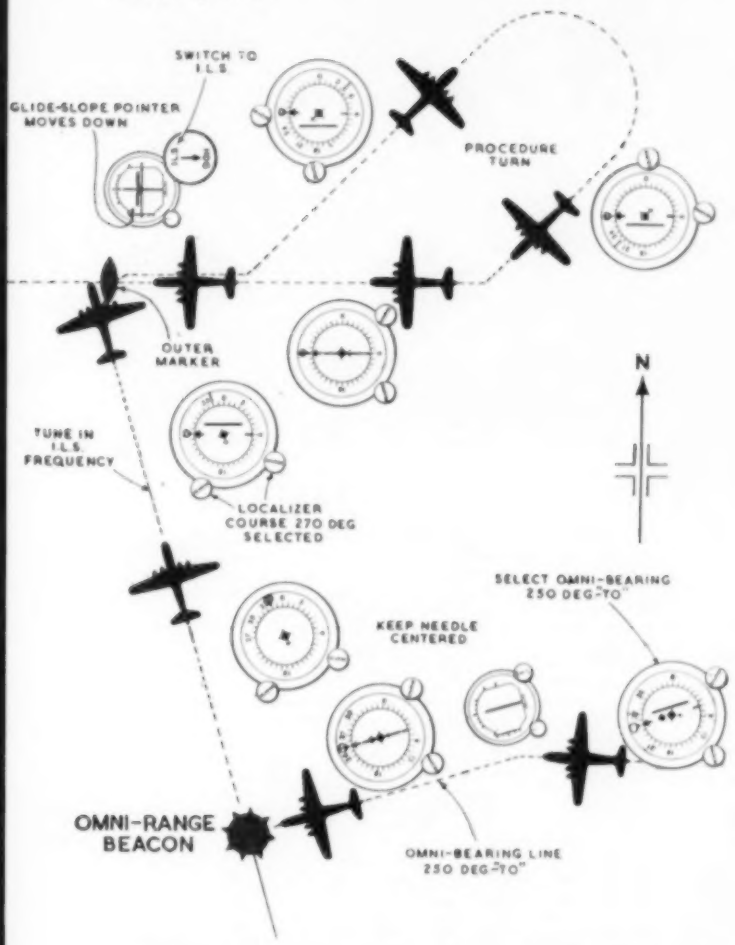
Both the approach horizon and the course indicator can be used to turn on to and to hold a compass heading. The I.L.S./HDG switch is turned to HDG and the heading selector knob used to turn the heading marker to the desired point on the azimuth ring. Thereafter, so long as the aircraft is on the selected heading and in straight and level flight, the steering needle will remain centered. Any deviation in bank or heading will cause the needle to move to the left or right and the pilot then follows the needle indication by applying bank to restore the flight-path. To turn smoothly on to a selected heading, it is simply necessary to follow the steering needle by banking the aircraft with it.

So far, only the outer portion of the course indicator has been mentioned; the central portion, related solely to radio aids, functions in the following manner. With the I.L.S./HDG switch at HDG, the navigation receiver is tuned to the desired V.O.R. beacon. When within range of the station, the red flag in the approach horizon marked LOC will disappear and the course bar will deflect. If the course arrow is rotated until the course bar lines-up with it, it will indicate the bearing of the V.O.R. station. If, on the other hand, it is desired to approach the V.O.R. station from a given direction, the course arrow is set to that direction and the heading pointer set, for example, to a 50-deg cut-off vector. The steering needle will then direct the pilot to apply bank and turn on to the course, giving him instructions which will make him hold his lateral attitude and heading.

When the course bar begins to close the course arrow, the heading pointer is rotated to coincide with the course arrow, and the steering needle will then direct the pilot on to the V.O.R. bearing. During this time, the to-from pointer should coincide with the head of the course arrow to ensure that the pilot is flying towards, and not away from, the beacon. When the aircraft is on course towards the beacon, the heading pointer, course arrow, to-from pointer and course bar will all line-up with the lubber line and miniature aircraft to form a straight white line along the aircraft heading. Any deviation from course will appear as a displacement of the course bar, each dot on the transverse scale equalling 2 deg error.

If a cross-wind affects the aircraft the heading pointer should be offset in proportion, and in opposition to the drift. The steering needle will then be centered when the aircraft is headed correctly to maintain the course to the beacon. Station passage is shown by reversal of the "to-from" arrow. It is easy to obtain a fix from a number of V.O.R. beacons by tuning in successively to each beacon and rotating the course arrow until the course bar lines up with it. The resultant series of bearings can then be plotted on a chart.

The two above functions can be combined to provide an indication of progress on a cross-country leg which does not pass directly over a beacon. If a course is plotted from one point to another with no beacon *en route*, the pilot can select a V.O.R. station some distance to one side of track, at the half way mark for example, and when he approaches it, he can set the course arrow at 90 deg to his heading and tune in to the V.O.R. station. As he approaches the V.O.R. radial, the course bar will indicate on which side of the radial the aircraft is flying. As it crosses the radial, the course bar will close the course arrow and



then gradually move over to the other side. When the course arrow and bar are lined up, he has an exact progress check which will assist him if he wishes in calculating the ground speed made good and in adjusting his E.T.A. accordingly. This type of pictorial indication of position relative to beams and V.O.R. stations is probably one of the most useful qualities of the Integrated Flight System.

The course indicator can also be used in conjunction with a visual-aural range (V.A.R.), but in this case it will only give an indication of being on one side or other of the green or red, or amber or blue airways. The particular sectors still have to be identified aurally. The fact that the course indicator will not show an exact relationship to a V.A.R. range station is due rather to the characteristics of the range than to the instrument itself. The V.O.R. coverage in the United States is in any case now complete except for one or two "blind" patches at 20,000ft, and V.A.R. ranges need not necessarily be used. While using the system for navigation the "LOC" and "G.S." failure warning flags may appear, but can be disregarded.

I.L.S. Approaches. Throughout the foregoing processes of navigation, the pitch bar and horizon bar of the approach horizon function in the same way as a conventional artificial horizon, using signals supplied by the vertical gyro. The vertical four-dot scale along which the pitch bar moves represents a pitch attitude change of 15 deg for each division. In order to assist in instrument flying, the pitch trim knob on the left of the approach horizon can be adjusted to "zero" the pitch bar on the horizon bar, thus compensating for deviations in the aircraft's pitch attitude arising from variations in loading and trim. Subsequently, during an I.L.S. approach, each division on the vertical scale of the approach horizon indicates a 10-deg pitch change.

To make an I.L.S. approach at the end of a cross-country flight, the pilot first homes, according to the local procedure in force, to the relevant V.O.R. or T.V.O.R. beacon, using the Integrated Flight System as described above. From the beacon to the I.L.S. outer marker is a procedure leg which can be set up with the heading pointer. Shortly before intercepting the I.L.S. localizer beam, he sets both the course arrow and the heading pointer to the in-bound localizer course and tunes in to the requisite I.L.S. localizer, glide slope and marker beacon frequencies. The red flags marked G.S. and LOC will move out of sight on the approach horizon dial when the aircraft comes within range of, respectively, the glide-slope and localizer transmitters. These flags appear when the services are out of range, not used or unserviceable. The I.L.S./HDG switch is set at HDG and the course bar deflects to show the aircraft's relation to the I.L.S. beam. From this point until the final approach is begun, the steering needle should be ignored.

At the outer marker, the pilot flies out-bound along the beam with the lubber line on the tail end of the course bar. Using the course indicator as for *en route* navigation, he makes the required procedure turn to begin the I.L.S. in-bound leg. Then, just before the outer marker is passed, in-bound, the I.L.S./HDG switch is set to I.L.S.

The steering needle can, if required, be used during the procedure turn by setting the heading pointer to coincide with the aircraft heading during the turn; but, while the 180-deg course alteration is being made, the heading pointer should be adjusted in stages, not more than 90 deg at a time.

When "I.L.S." is selected, the glide-slope pointer will, in the normal way, show the aircraft well below the glide-slope until it reaches a point where it intercepts it. Thereafter, with the aircraft in the landing configuration, the pitch bar is matched with the glide-slope pointer, and the approach horizon will provide attitude, steering and glide-slope information. The glide-slope pointer gives a direct and not a computed indication. When the aircraft is on the glide-slope, cross-wind correction is made automatically, and a bank-limiter prevents the application of more than 25 deg of bank.

The pilot should aim in all cases to keep the steering needle central. Thus when, as in the accompanying chart, he finds himself to the left of the I.L.S. beam, the needle tells him to steer to the right. He then banks to the right and the needle once more centres, so that it gives an on-course indication as soon as he is closing the beam correctly. The course indicator will, however, show him that he is to one side of the beam. As he closes it, the steering needle will deflect to the left, and by rolling the aircraft he will return the needle to centre and will join the beam smoothly without overshooting. The steering needle provides steering

"Flight" photograph

The Integrated Flight System instruments installed in the first pilot's panel of the Civil Aeronautics Administration C-47 Dakota based at London Airport. Besides the I.F.S. the aircraft carries V.O.R., twin A.D.F., D.M.E., duplicated I.L.S., Sperry A.12 autopilot and approach couple and much else; it must surely be one of the most comprehensively equipped aircraft in Europe.

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instructions from computed heading-displacement, beam-displacement and bank signals. A "kinked" localizer beam will cause the steering needle to flicker, and an average reading should then be used.

To overshoot, the pilot sets the I.L.S./HDG switch to HDG and, using the heading pointer and steering needle, climbs away as instructed. If, on some occasion, a back-beam approach is necessary, the course arrow is set to the I.L.S. in-bound course, the heading pointer on the tail of the course arrow, and I.L.S./HDG switch to HDG. The back beam can then be followed with the steering needle and any wind-drift which becomes apparent can be counteracted in the normal way by offsetting the heading pointer. The I.L.S. beam is thereafter handled in much the same way as a V.A.R. beacon.

The foregoing description may give the impression that the Integrated Flight System is over-complicated. Actually, however, it has a great advantage, in that the indications from both the course indicator and the approach horizon are as far as possible directly pictorial and incorporate attitude reference, and also that the indications are given in the natural sense. Perhaps one of the most difficult parts of flying with radio navigation equipment is the mental interpretation required to make sense of a number of readings in relation to a desired flight-path. Aural signals in particular require practice and concentration by the pilot if he is to interpret them correctly when busy—for example, during an approach in really bad weather. Anyone with experience of S.B.A. approaches will be fully aware of this problem. The I.L.S. cross-pointers with their blue and yellow lefts and rights also require practice and correct interpretation.

The Collins system on the other hand, supplies computed, pictorial indications which can be followed directly to produce a desired result. Hunting, and overshooting of either the glide slope or the localizer beam, can more easily be avoided because the steering needle and pitch bar indications are designed to feed the aircraft on to the beam, so to speak, rather than to tell the pilot how far away from it he is.

With the FD-104 controlling an autopilot on an I.L.S. approach, furthermore, the Integrated Flight System instruments are probably the easiest way of monitoring the functioning of the autopilot. One need only watch the comparative behaviour of one of these instruments and an I.L.S. cross-pointer meter to appreciate the value of the Integrated Flight System.

PLASTIC DROP-TANKS FROM FILTON

DROP tanks, as used for extending the range of fighters, are an item of equipment often taken for granted. They are not, however, quite such simple components as is generally assumed, nor are they particularly cheap; it is said, for instance, that they constituted the largest item of expenditure by the U.S.A.F. in the Korean War, when thousands were dropped every week—and they cost between £200 and £300 each.

With a view to economizing both in cost and in the use of strategic material there is now a move in the direction of using plastics in place of light alloys for the manufacture of drop tanks. The first cost of the plastic tank is stated to be between 25 and 30 per cent less than that of its aluminium equivalent.

It is not generally known that for the past three years the Bristol Aeroplane Co. has been carrying out a development programme for the design and manufacture of a standard type of plastic tank and that large-scale production is now being planned following the receipt of M.o.S. orders. These orders were an outcome of the plan for standardizing drop tank sizes on new (and where possible existing) Service aircraft. Standardization will, of course, greatly assist mass production. The standard sizes so far developed at Bristols have capacities of 50, 100, 150, 200, 300, and 500 gal. Further standardization has been achieved by making the front and rear shells of the 100 and 150 gal tanks identical, the larger tank having a longer centre shell; in addition, the 200- and 300-gal tanks have common front and rear shells.

Bristol plastic tank for Hawker Sea Hawk.

Production processes used are adapted from those developed by the company in early work on primary aircraft structures in plastics. Cylindrical fuselage sections were moulded by the autoclave process and frames and wing sections by hydraulic press moulding, and these procedures proved adaptable for, respectively, the drop tank shell and the internal framework. The material used is asbestos felt impregnated with phenolic resin; a "short-fibre" asbestos (instead of the long fibre generally used in aircraft work) is employed, since supplies are plentiful. The three main shell sections have high-pressure-moulded internal frames assembled by hot gluing. The basic aerodynamic design is by the R.A.E., but the structural design is by Bristols, and a number of the production methods employed are covered by the company's patents.

The three-section method of construction simplifies storage, for the shells of several tanks can be placed together to give a nesting ratio of about 3 : 1. The sections can, it is stated, be assembled in the field by two or three unskilled men in under 15 minutes; no adhesive is required and the only tool necessary is a screwdriver. Provision is made for various types of air/fuel connection to be screwed into the tank ports to meet varying design requirements, and an automatic float switch can also be fitted for use with pressure fuelling.

The pick-up point on the tank is designed to fit the standard bomb or under-wing store-attachment point; it can also be readily adapted to fit the two-lug American-type mounting or a jettison-gun mounting.

A fin—adjustable in incidence to suit the characteristics of particular aircraft—is fitted to counteract any pitching moment and thus ensure a clean fall-away.

Plastic tanks can be given a finer surface finish than aluminium tanks, and the surface can, of course, be painted in any colour desired. The material used is unaffected by extremes of temperature or humidity, and Bristol plastic tanks have already been used successfully in Africa. A metal cap, moulded integrally with the shell, is fitted to the nose of each tank to reduce erosion by hail and rain. It is stated that the 100-gal tank adopted for the Hawker Hunter has been flown on that aircraft at supersonic speeds without affecting performance.

In addition to the standard range of tanks the Bristol company has developed versions for certain aircraft already in production; identical in shape (and comparable in weight) with their metal counterparts, these tanks cost considerably less. One example is a 250-gal wing tank for the Canberra, and others include the pylon tank for the Sea Hawk and pylon and tip tanks for the Venom. Design and development, state the Bristol company, is in fact proceeding with drop tanks for the majority of front-line British aircraft.

ALAN MARSH MEMORIAL FUND

AS briefly announced last week, the Helicopter Association has set up a trust fund in memory of the late Henry Alan Marsh, A.F.C., A.F.R.Ae.S. It is to commemorate "his inspiring and selfless devotion to the development of rotating-wing aircraft, and the prominent place that he took in forming the Helicopter Association of Great Britain."

The memorial is to take two forms: monetary grants to be made to assist the careers of young persons employed in the helicopter and associated industries, and medals to be awarded to individuals for outstanding work in any of the fields associated with the science and practice of helicopter engineering and operation.

Trustees appointed by the Helicopter Association are Messrs. R. A. C. Brie, L. G. Frise, W. G. Leslie, and H. Grinsted. The fund has been opened with a gift of 50 guineas from the Association and another of £250 from Mr. A. J. Mollart of the Mollart Engineering Co. Contributions, now invited by the Association, can take the form of donations or annual subscriptions, the latter preferably under "deed of covenant" over a period of seven years in order that the trust may apply for refund of income tax upon them. Contributions should be addressed to the Alan Marsh Memorial Trust, c/o The Helicopter Association of Great Britain, 4 The Sanctuary, Westminster, London, S.W.1.

Alan Marsh, who lost his life at the age of 49, while testing the Cierva Air Horse in 1950, first started flying rotating-wing aircraft when he joined the Cierva Autogiro Co. in 1932. Altogether, 3,500 of his 6,500 hours of flying were on aircraft of this type.

SOUTH AFRICAN AIRWAYS

An Outline History of the Union's 21-year-old Airline

A TWENTY-FIRST birthday has just been celebrated by South African Airways, for it was on February 1st, 1934, that the airline assumed control over Union Airways, South Africa's first scheduled air carrier. Under the directorship of the late Maj. A. M. Miller, this private company had begun operations on August 26th, 1929, with a fleet of five D.H. Gipsy Moths.

Union Airways' initial mail services were primarily intended to connect Johannesburg, Durban and Port Elizabeth with the mailboats at Cape Town. Later the fleet was augmented with Puss Moths, Junkers F.13 and W.34 four-seaters and a Fokker Super-Universal. Passenger services were introduced, and the company's headquarters were moved from Port Elizabeth to Durban.

Under an Act passed in 1931, the South African Railways Administration was given authority to operate its own departmental aircraft for the carriage of passengers and goods. As noted above, the Act was not implemented until 1934, when control was taken of Union Airways, which was now finding difficulty in keeping pace with growing traffic demands.

The South African Railways financed the new enterprise, which remained a separate entity. Services were inaugurated with the three Junkers F.13s and one W.34 taken over from Union Airways, but these single-engined aircraft were soon to be replaced. On November 1st, 1934, three Junkers Ju 52 three-engined 14-passenger aircraft, which had been on order by Union Airways, were placed in service on the more important routes. The advent of the larger aircraft, and the improved regularity resulting from the adoption of airborne D/F. and communications wireless, as well as direction-finding stations at certain of the major towns, proved a stimulus to air traffic. Further Ju 52s had to be purchased the following year and a new service between Johannesburg, Kimberley and Cape Town was introduced on April 1st, 1936. This route had previously been flown by Armstrong Whitworth Atalantas of Imperial Airways as part of the London to Cape Town service.

Meanwhile, on February 1st, 1935, S.A.A. had taken over South West African Airways, whose fleet of two Junkers A.50s and one F.13 had operated within the Mandated Territory and in 1932 had introduced a weekly airmail service between Windhoek and Kimberley. The weekly service was continued with F.13 aircraft and was arranged to connect with the service between Johannesburg and Cape Town. On July 1st, 1935, headquarters were transferred from Durban to the Rand Airport, as Johannesburg had now become the most important centre in the air network.

When, under the 1935 Empire Airmail scheme, it was decided to convey all first-class mail by air throughout the British Commonwealth, South and South West Africa became the first territories to adopt this policy. Soon afterwards orders were placed for Ju 52s, ten-seater Junkers Ju 86s and Airspeed Envoys. The first Ju 86 arrived in the Union on June 5th, 1937, and by the end of 1938 many of the new aircraft were in service and an increase in the number of services was possible. The remarkable growth in the first four years of South African Airways' existence is clearly shown by the following figures:—

	1935	1938
Number of aircraft (multi-engined) ...	4	26
Number of pilots	11	31
Total staff	57	273
Total passengers	8,938	34,162
Aircraft mileage flown	522,257	1,862,195

Routes operated at this time included Johannesburg to Durban, Johannesburg to Cape Town, Durban to Cape Town, and Johannesburg to Bulawayo, Lourenço Marques, Windhoek, Kisumu (Uganda) and Port Elizabeth. Meanwhile, negotiations were afoot with the Belgian and Portuguese authorities for the inauguration of a circular route linking the Union with Portuguese Angola and the Belgian Congo and connecting with the service to Kisumu.

The first section of this route was opened on August 21st, 1939, with a service between Johannesburg and Luanda in Angola, but before negotiations for the extension of the route could be completed war broke out and the plan was shelved. Nevertheless, the opening of this service served to complete an extra-territorial network of regional services linking the Union with all the adjacent territories—Mozambique, South-West Africa, Rhodesia and Angola.

Upon the outbreak of World War II, the fleet of 18 Kestrel-powered Ju 86s with their complement of airscrews and ground personnel were placed on a military footing as a Defence Wing,

Two pictures which span 20 years in the history of S.A.A.: (above) one of the airline's four Constellation 749As over Johannesburg; and (right) a 1935 scene at the Rand Airport, showing passengers leaving a Ju 52.

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the aircraft being converted to bombers in South African workshops. Two squadrons were posted to the coast, where they carried out anti-submarine and reconnaissance work, and a third went to Abyssinia for bombing operations against the Italians.

The airline's remaining eleven Ju 52s continued to operate an internal skeleton service until May 24th, 1940, when all commercial air services in the Union were suspended and the complete Airways organization was transferred to the South African Air Force, the Ju 52s being utilized for military transport purposes between the Union and Abyssinian theatre of war, and later operating on the lines of communication to North Africa. When, later in 1940, the fleet of 28 Lockheed Lodestars ordered by S.A.A. before the war arrived in the Union they were immediately transferred to the S.A.A.F., but were largely operated by Airways crews until new crews could be trained by Airways instructors. Many S.A.A. aircrews and ground personnel served with distinction in the South African Air Force up to the end of the war.

The S.A.A.F.'s acquisition of a number of Dakotas in 1944 and the favourable turn of events in the war situation made it possible for the Defence Department to release some of the Lodestars from the shuttle service operating between the Union and the North African theatre. At the outset the schedule was limited to a daily service between Johannesburg and Durban; three services a week between Johannesburg and Cape Town, *via* Durban, East London and Port Elizabeth; two a week between Johannesburg and Cape Town by the direct route *via* Kimberley or Bloemfontein, and a weekly service between Johannesburg and Salisbury, *via* Bulawayo.

As more Lodestars became available, the frequency of the services was increased and an additional service was introduced between Johannesburg and Port Elizabeth, to be followed later by services to Windhoek.

The continued demand for more accommodation made it necessary for the fleet to be increased, and towards the end of 1945 three Skymasters were added to the twelve Lodestars then in service. These large aircraft were used to inaugurate a direct non-stop daily service over the 800-mile route between Johannesburg and Cape Town on May 1st, 1946, on which day, too, it was decided to reintroduce the carriage of all first-class mail by air without surcharge.

S.A.A.'s first trunk service, between Johannesburg and London, known as the Springbok service, was started as a partnership venture by South African Airways and B.O.A.C. on November 10th, 1945. It was operated initially with Yorks, subsequently replaced by Skymasters (S.A.A.) and Solents (B.O.A.C.).

The next major event in S.A.A.'s history was the acquisition, in 1950, of four Lockheed Constellation 749As which cost, with spares, nearly £2m. These aircraft were introduced to service on the Springbok route at the end of 1950 and are still thus employed, operating in both 42-seat (first-class) and 58-seat (tourist) form. For their main internal services, S.A.A. have a fleet of seven 46-seat Skymasters, the secondary routes being served by five 21-seat Dakotas and nine 12-seat Lodestars.

The first step towards re-equipment was taken last year, when S.A.A. placed a £3m order for three Douglas DC-7Bs for delivery early in 1956.

Throughout its 21-year history the airline has operated as a State-owned service under the South African Railways Administration. In recent years it has been suggested that S.A.A. would function better if its management was wholly divorced from that of the railways, but the Union Government has given no indication that such a change in policy is likely. Since its inception the airline has suffered only two fatal accidents and it has achieved a high reputation for regularity and service.

On the Springbok route S.A.A. operate one first-class and three tourist-class return services weekly. Other services are operated between the following terminals: Johannesburg to Durban, East London (*via* Durban), Port Elizabeth, Cape Town, Windhoek, Lourenço Marques and Bulawayo; Durban to Cape Town; Cape Town to Windhoek; and Windhoek to Livingstone.

S.A.A.'s centre of operations is the new Jan Smuts Airport at Johannesburg, where over 1,000 technicians are employed in the airline's hangars and workshops. The total staff of S.A.A. is 2,065 (including 391 non-Europeans); flying staff total 301, including 103 pilots.

The growth of the airline during 21 years of existence can be assessed from the following comparative statistics; route mileage operated during the latest financial year, incidentally, was 27,303.

	1934-35	1949-50	1953-54
Expenditure	£4,589	£3,484,075	£5,458,253
Revenue	£2,677	£3,466,784	£5,769,206
Internal passengers	3,074	117,663	170,630
Regional ,,	—	13,926	20,602
Trunk ,,	—	9,122	19,644
Cargo (ton-miles)	N.A.	1,048,993	1,933,203
Hours flown	N.A.	38,707	29,179
Miles flown	266,494	7,347,440	6,266,665
Number of aircraft	4	41	27

THE TV FILM: RISING SUN SETS

AIR power in South-East Asia formed the theme of *Eastern Victory*, Episode 13 of the B.B.C. Television film *War in the Air*. The film opened with scenes of airfield construction, including a hard-to-believe shot of a bomb trolley being hauled by a brace of *bears*. By the beginning of 1944 South-East Asia Command included 48 British and 17 American squadrons, in addition to the Indian Air Force and over 100 transport aircraft.

The vital part played by air supply in enabling us to "fly where we will over an 800-mile-long jungle front" was admirably portrayed. The 80-day seige of Imphal (during which up to 500 tons of supplies were air-dropped daily) and Wingate's second Chindit expedition, in March 1944, were both covered. During this latter operation, 10,000 men and 1,000 mules, together with vast quantities of supplies, were dropped. This sequence included brief shots of Vultee Vengeance bombers, many shots of ubiquitous Dakotas, and two Hadrian gliders landing—one shedding pieces of wing as it ploughed through the undergrowth, the other ending nose-down in water.

Following sequences depicted vividly the appalling conditions in the jungle beneath the aerial activity. A Tiger Moth was shown on casualty evacuation—one part of the air war which was not, perhaps, given sufficient prominence—and this was followed by shots of Liberators on strategical missions escorted by Hurricanes.

In March 1945 came Operation Dracula, designed to retake Rangoon before the Monsoon broke. Heavy bombers battered the defences, while airborne and seaborne forces, with Tactical Air Force support, were landed on the coast just south of the city. Sequences depicting close air-support showed napalm bombs being dropped for the first time in the series, although this dreadfully effective weapon was not mentioned.

With the fall of Rangoon, the film switched to the Pacific and Okinawa. In the Pacific, the number of U.S. carriers had increased from one to a hundred, and the sequence of operations for the conquest of the island followed that developed during many previous air-sea assaults. These were: (1) the destruction of enemy air activity; (2) heavy naval bombardment; (3) bombing and ground-attack prior to and during the actual assault.

Okinawa saw the fiercest Kamikaze activity of the Pacific war and of much interest was a shot implied to be a massed take-off by some dozen of these "suicide" aircraft. It is a pity that more time was not allocated to this phase of the air war; a whole episode would not have been too long to cover the attacks adequately. The film did not stress that the flights were not "suicidal" in the general meaning of the term; they were essentially a religious rite, and the pilots derived glory from taking part in them. Nor was it mentioned that organized Kamikaze attacks restored to the Japanese an effective air weapon which they had not had since they lost their best pilots in the Solomons two years previously. In the ten months during which they operated, Kamikaze aircraft accounted for nearly half of all the U.S. warships damaged, and 21 per cent of all the ships sunk during the war. Nearly 2,000 Kamikaze attacks were made at Okinawa, and 279 ships hit—not "500 sunk or damaged" as mentioned in the commentary. No mention was made of the Baka rocket-propelled bombs designed specially for Kamikaze work.

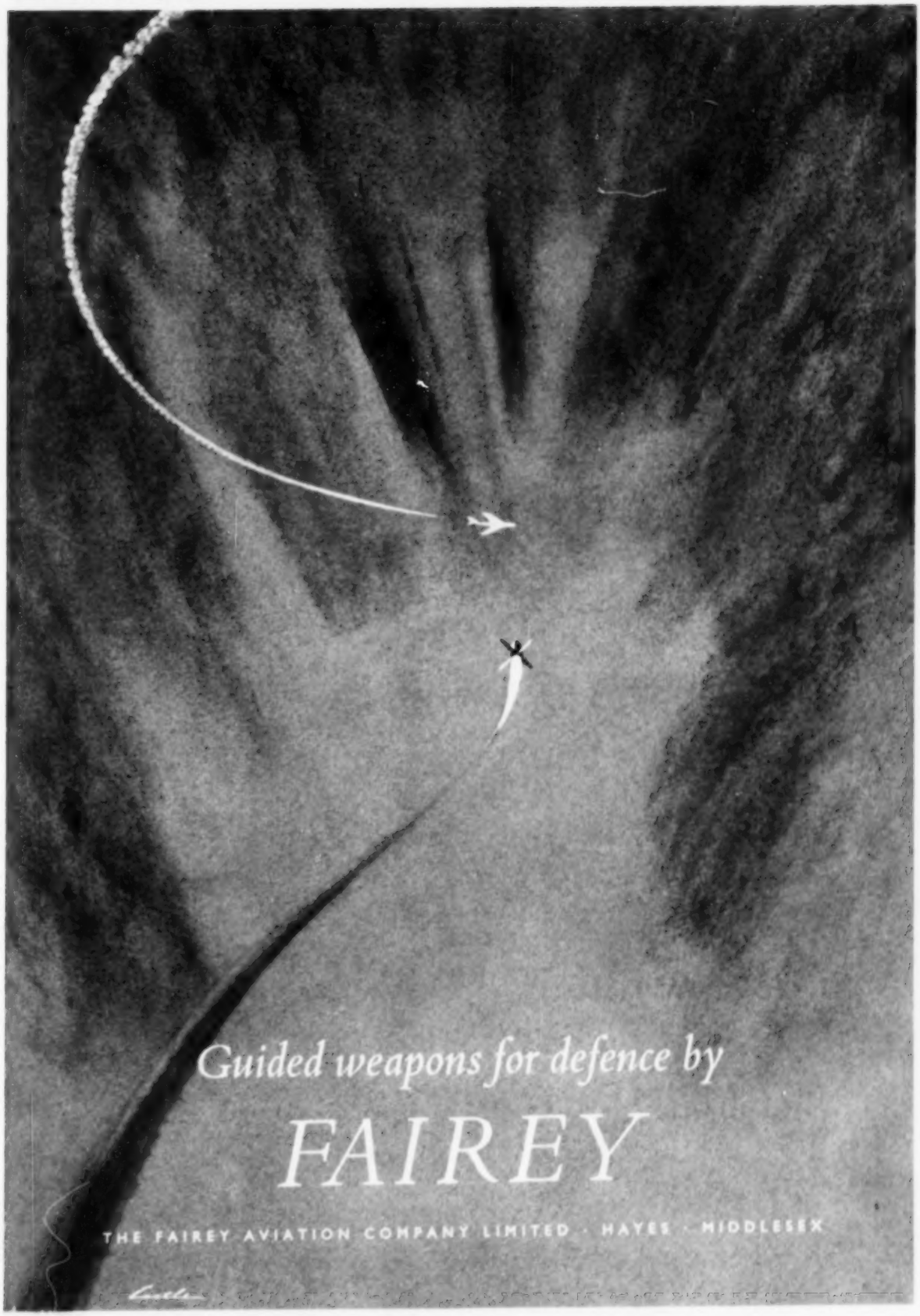
Defensive measures included an advance screen of about 100 destroyers fitted with early warning radar, some 600 fighters available for anti-Kamikaze patrols and 7,400 anti-aircraft guns. In Britain development work on the Fairey Stooge, designed for use against Kamikazes, was intensified.

In spite of this brief coverage, however, the film managed to convey the difficulty of combating these "guided missiles" and included some spectacular shots of attacking aircraft breaking up under intense anti-aircraft gun fire.

Air operations against the Japanese mainland occupied the remainder of the film. The sequences covering B-29 raids against Japan, and the figure of "30,000 sorties in a few months" will have helped to bring home the severity of these long-range American raids, which had virtually won the war before the atom bomb exploded over Hiroshima.

Some 3,000 bombers were lost on these missions; the value of Iwojima (a minute island some 800 miles south of Tokyo) as an emergency landing ground, was covered, although its importance was not, perhaps, sufficiently stressed. Over 2,000 B-29s and no fewer than 24,000 aircrew were saved by emergency landings on the little island. These crippled B-29s were shown landing; one, with starboard outer engine dead, was seen to make a heavy landing, one ditched in the sea, and one, skidding along after a wheels-up landing, burst into flame, from which some of the crew appeared to escape.

M. F. A.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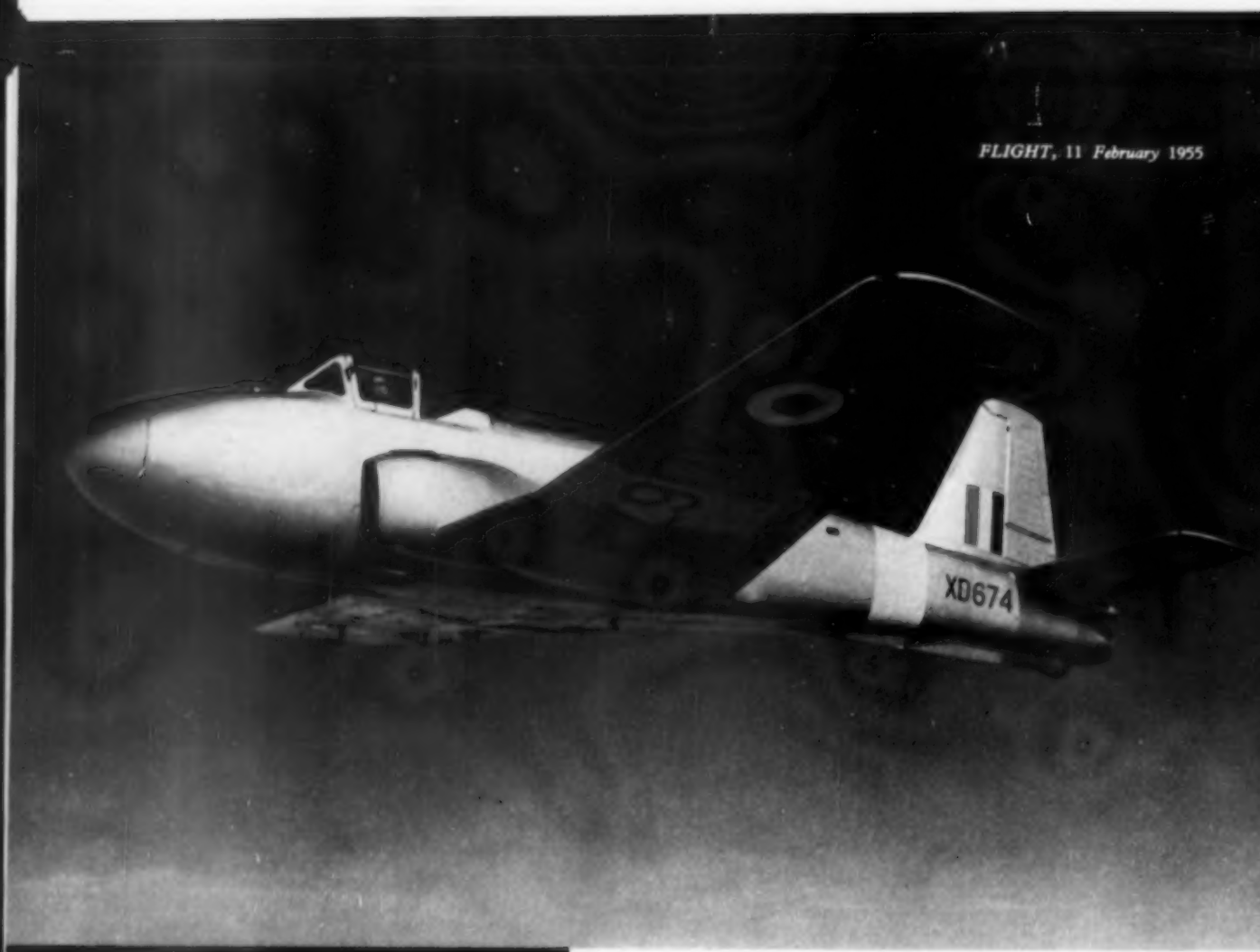

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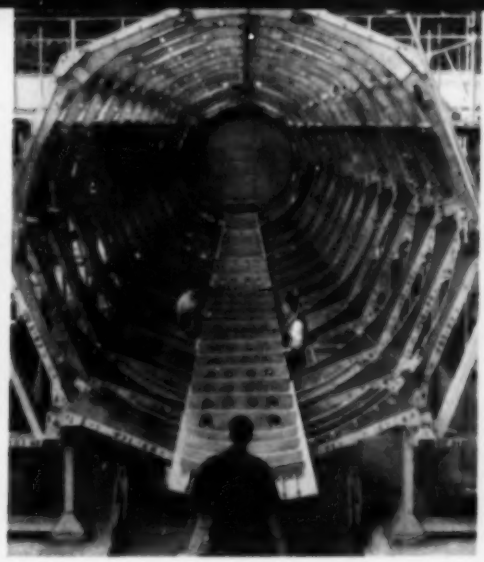
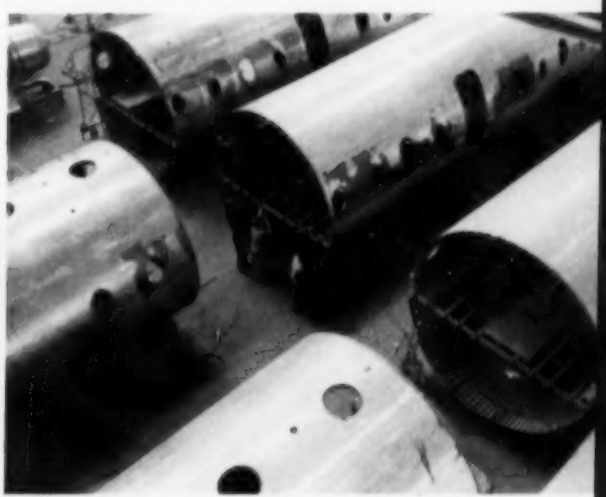


The Britannia fuselage is made up of a series of panels (left), most of which measure 23ft by 3½ft, the front and rear sections of the fuselage being built up separately. To make up the rear-fuselage section, ten panels are assembled in a circular jig (centre); after assembly the lower segments of the jig are removed (right) and the fuselage section is wheeled on to the floor of the erecting shop.

Britannia Assembly— A Fleet in the Making

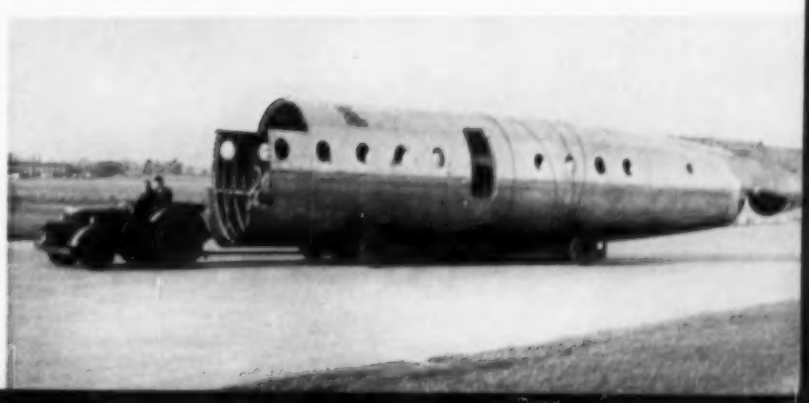


After removal of the fuselage section from the jig, work proceeds on floor structures, installations and services.

ASSEMBLY, rather than production in the accepted sense, is the theme of this picture-story of Britannia manufacture. Bristol's turboprop airliner is built up at Filton from a series of major assemblies, many of which are made elsewhere by sub-contractors. Front and rear fuselage assemblies take shape in the erecting shop, but the mating-up process does not begin until all major components have been positioned in the assembly hall. The present production programme envisages an output of 25 Britannias annually from Filton, and this rate would be doubled by the setting-up of a

(Above) The completed rear-fuselage section is lifted by crane, enabling trolleys to take the place of its supporting bogies, which can now be returned to their original position in the jig.

Completed sections are towed from the erecting shop to the assembly hall (illustrated overleaf).

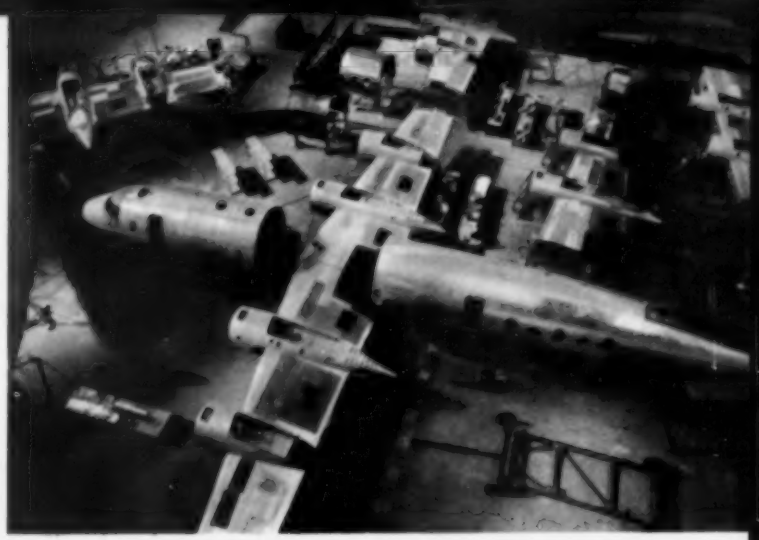


BRITANNIA ASSEMBLY . . .

second assembly line in the Short Bros. and Harland factory at Belfast.

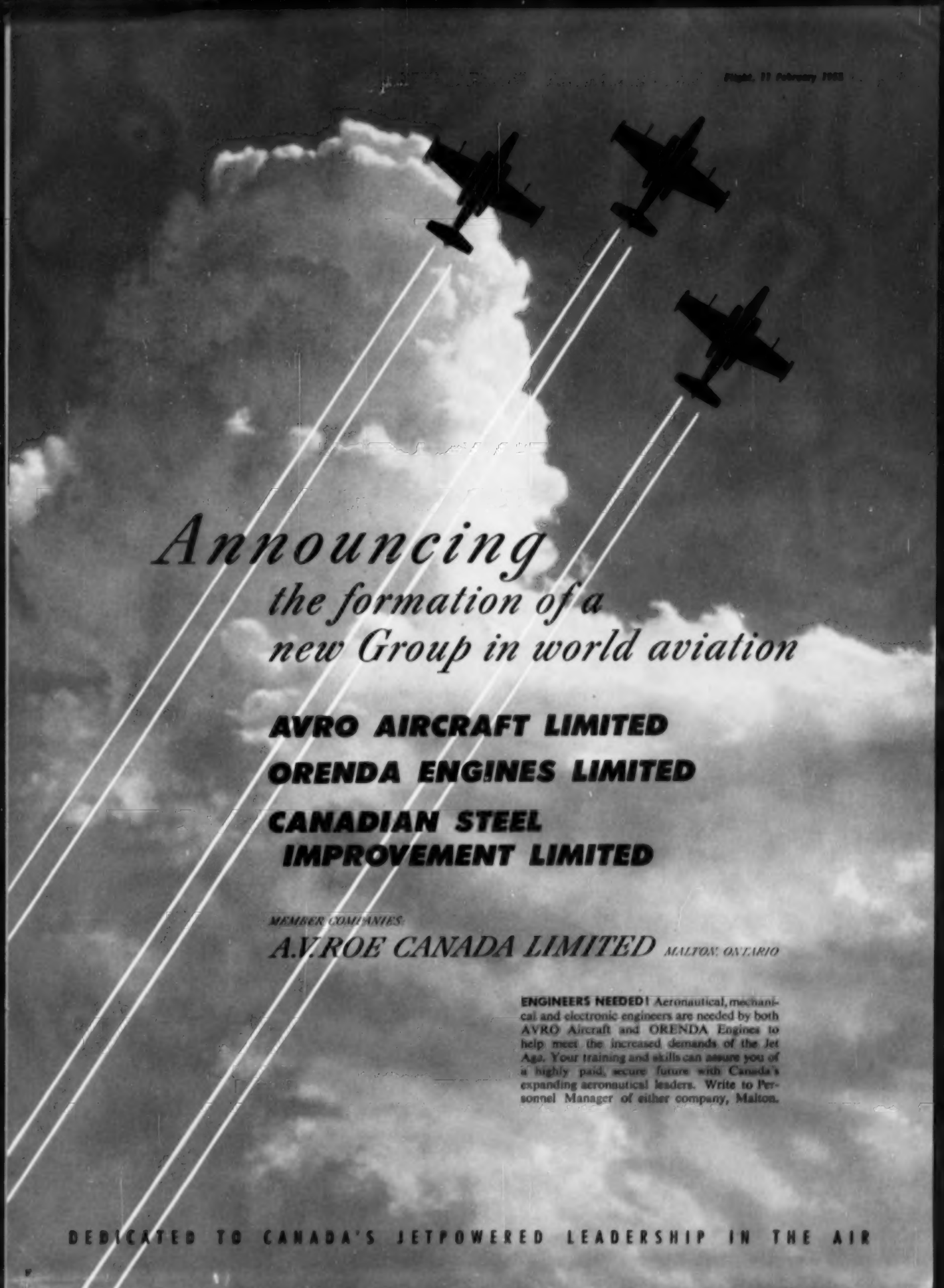
Provision has been made for a smooth changeover from the Britannia 100 to the Mk 300, which has a 10ft 3in fuselage extension incorporated in the centre-section "canopy" and the rear fuselage. Since the centre-sections are made by Blackburn and General Aircraft, only minor jig modification is required at Filton. In one of the two bays flanking the assembly hall illustrated on this page, the first Mk 300 fuselage is already well on the way to completion.

In the assembly hall (right), components of a Britannic are seen ready for mating-up. The centre-section "canopy," which joins the front and rear sections, has yet to be lowered into position.



(Above) This overhead view of the spacious, superbly appointed assembly hall at Filton finds seven Britannia 100s (Nos. 3 to 9 inclusive for B.O.A.C.) in various stages of completion. The hall has accommodation for eight Britannia airframes.

The finished article (below): Britannia 100 G-ANBB, second of B.O.A.C.'s order for 15, which made its maiden flight last month.



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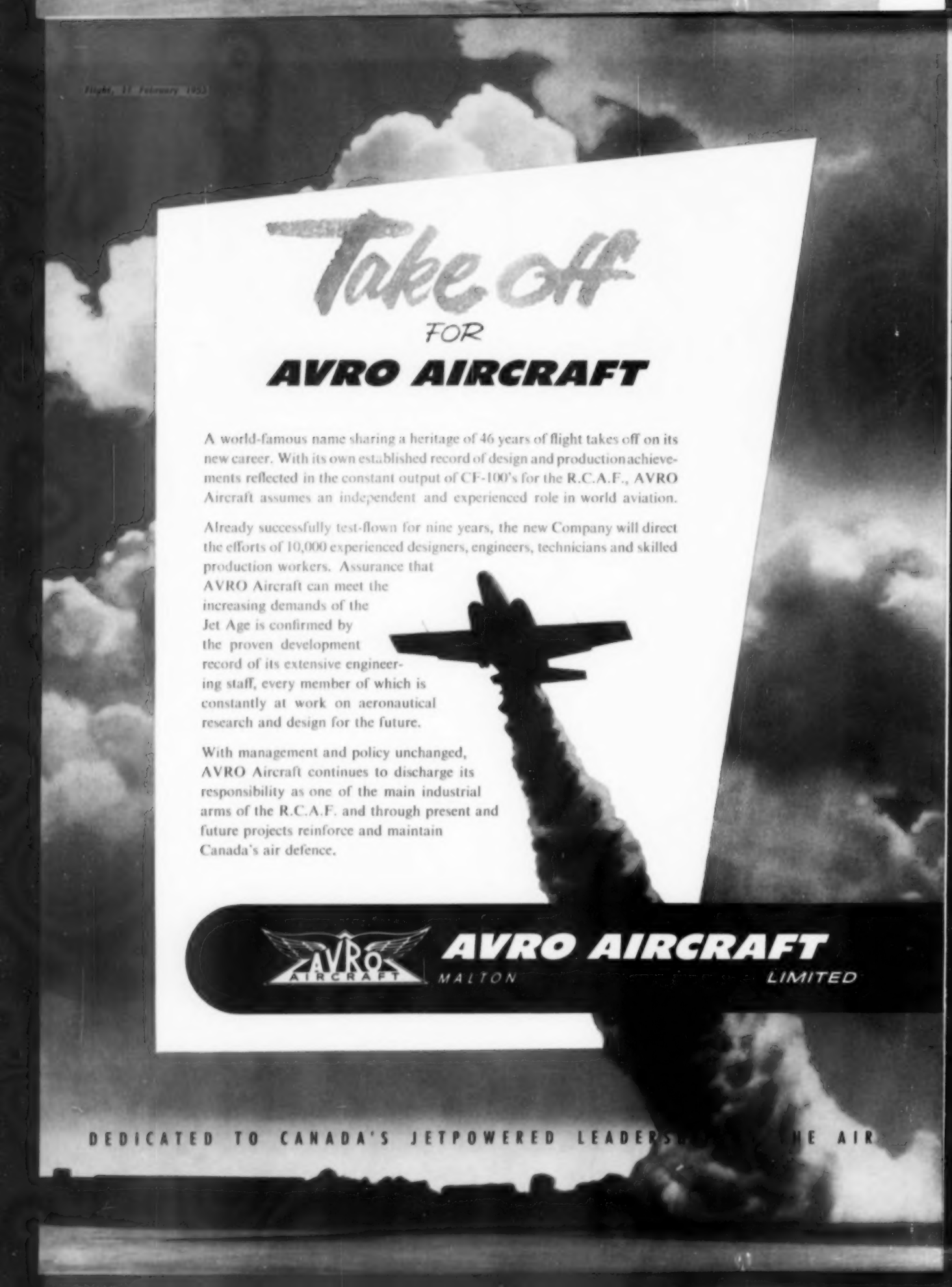

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A world-famous name sharing a heritage of 46 years of flight takes off on its new career. With its own established record of design and production achievements reflected in the constant output of CF-100's for the R.C.A.F., AVRO Aircraft assumes an independent and experienced role in world aviation.

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With management and policy unchanged, AVRO Aircraft continues to discharge its responsibility as one of the main industrial arms of the R.C.A.F. and through present and future projects reinforce and maintain Canada's air defence.

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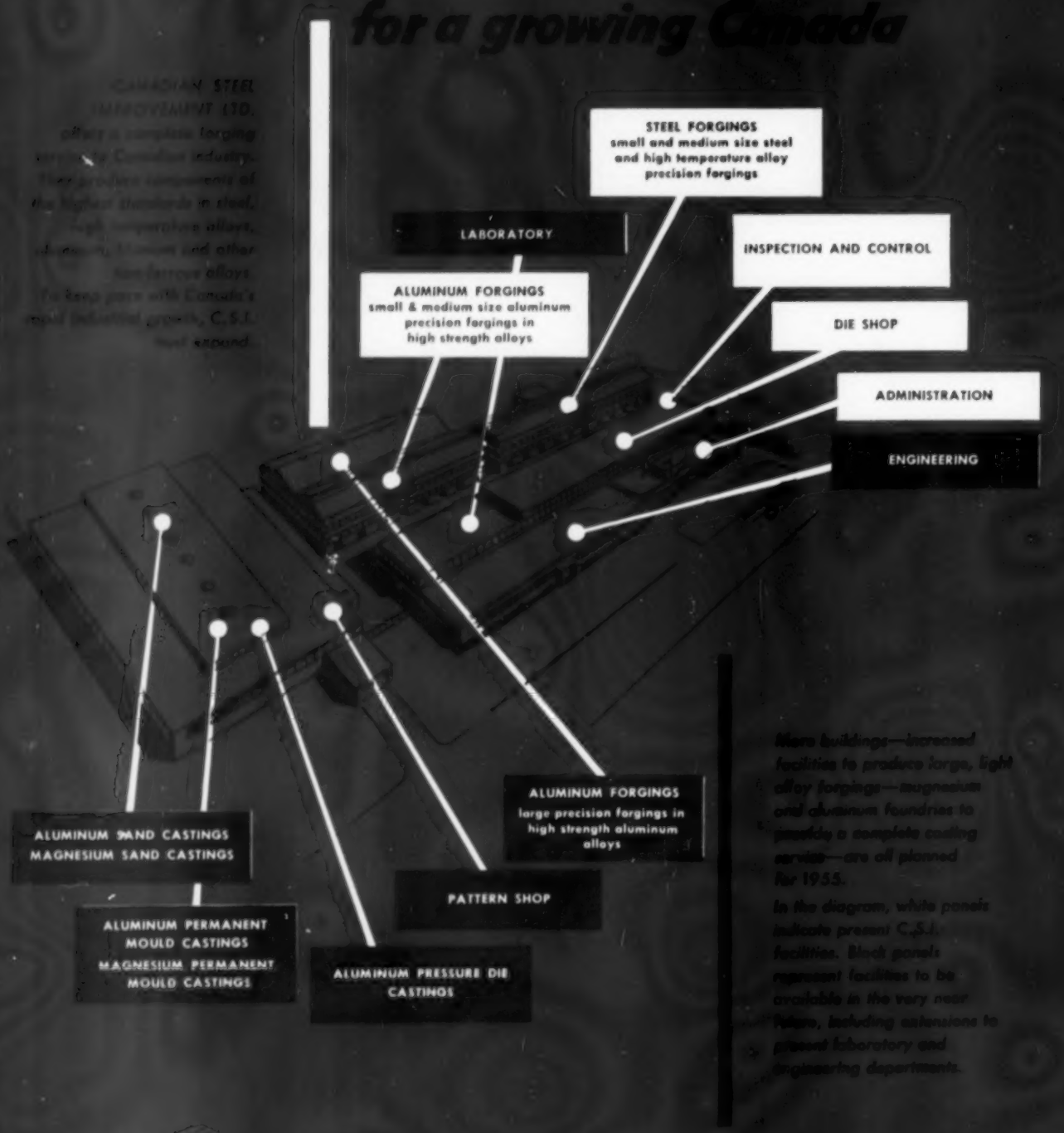

More buildings—increased facilities to produce large, light alloy forgings—magnesium and aluminum foundries to speedily a complete casting service—are all planned for 1955.

In the diagram, white panels indicate present C.S.I. facilities. Black panels represent facilities to be available in the very near future, including extensions to present laboratory and engineering departments.

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AIRCRAFT INTELLIGENCE

The Grumman Cougar (above, right) is gradually being superseded in production in favour of the F9F-9 Tiger (first prototype shown). The Cougar illustrated is an F9F-6 (J48) carrying two 1,000 lb bombs. It is just sonic in a 25 deg dive; the Tiger, however, is easily sonic on the level.

Great Britain

Folland Gnat. Modifications to make the Gnat suitable for shipboard operation would consist only of strengthening the undercarriage and fitting an arrester hook. Since the span is so small, no wing-folding would be required. Production of the Gnat is foreseen for 1957, with supersonic Mk 2 and Mk 3 versions appearing respectively in 1958 and 1959.

New Insignia. Recently approved is the camouflage scheme for R.A.F. night attack aircraft (presumably typified by the Canberra B.8). Such machines will be finished in the usual dark green and medium sea grey above the fuselage centre-line; the whole lower half of the aircraft will be dark sea grey. In passing, it may be noted that the production Javelins so far completed have been finished in day-fighter camouflage (dark green and grey down to the bottom of the fuselage and silver underside); the authorized scheme for all-weather machines specifies a grey undersurface carried half-way up the fuselage sides (a uniform carried, surprisingly enough, by all the Javelin prototypes). The final recent change is that Fleet Air Arm machines will carry the words "Royal Navy" in letters as large as possible on the fuselage or tail boom; previously this was in 4in letters above the serial number.

Radome Finishes. Although there are, of course, authorized finishes for radomes, the surface colour varies. The nose cap of the Javelin, for example, is a very dark—almost black—colour; several aircraft retain a brownish colour, characteristic of the dielectric material used, and the large mouldings over the bomb-sight scanners of such aircraft as the Valiant are generally painted white. The colour of the scanner can have a profound effect on the "shape" of the aircraft when seen from a distance, particularly at high altitude.

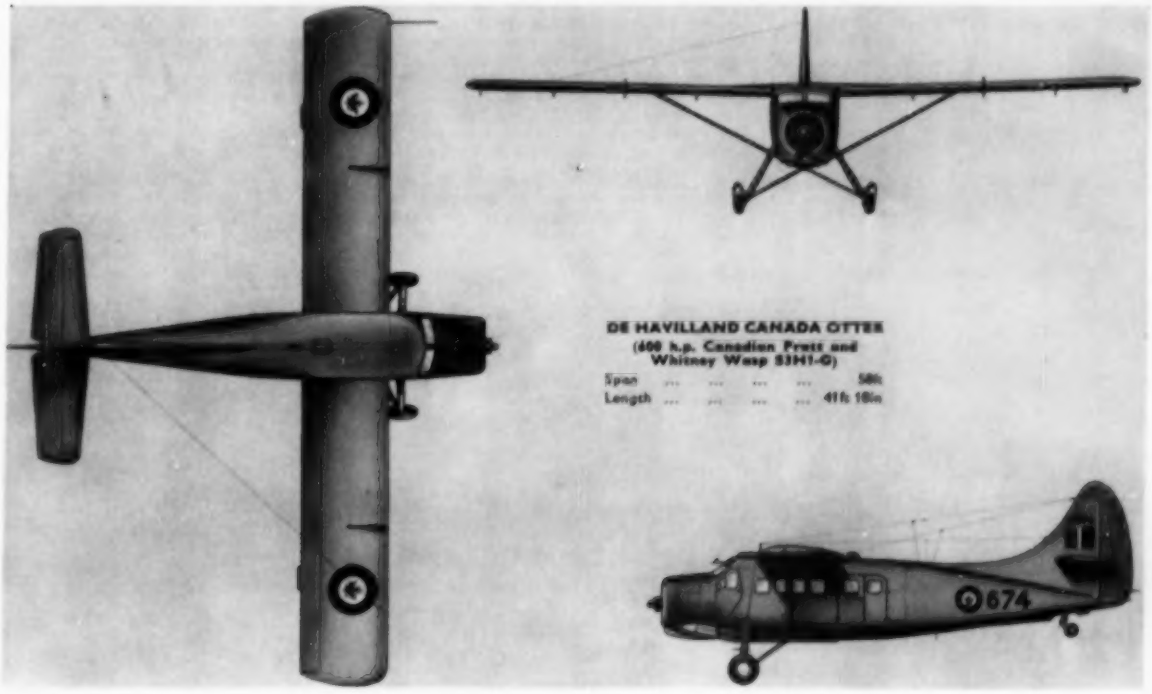
U.S.A.

Beechcraft. In 1954 Beechcraft produced 50 Model 18s, 97 Twin-Bonanzas and 322 Bonanzas; sales revenue for 1955 is expected to increase by 25 per cent over 1954. They also announced a new Bonanza, the F35, to go with the recently introduced Super 18 and C50 Twin-Bonanza. The F35 can have a 225 h.p. Continental engine and the airscrew blades have been shortened and squared off to lessen tip-losses. A third window has been added at the rear of the cabin side wall to give better visibility, and the flaps and undercarriage have been strengthened to allow extension at higher speeds. Some 4,000 Bonanzas have been completed. The F35 is one of the few light aircraft capable of passing C.A.A. Utility Category Tests at its full 2,750 lb all-up weight.

McDonnell F-101A Voodoo. The publicized prototype of this massive single-seat escort fighter/bomber (Machine 53-2421) has now joined two earlier prototypes in flight testing at Edwards A.F.B. It was flown there in company with a B-47B Stratojet (acting as navigator) direct from the McDonnell factory in E. St. Louis, a distance of 1,700 miles. The two other F-101s were air-lifted in C-124s.

Canada

D.H.C.3 Otter. It is now confirmed (see *Flight*, January 7th) that 84 Otters will be delivered to the U.S. Army, as C-137s. The first six will be in service early in March with the Corps of Engineers. These six will be supply aircraft on topographical survey operations in Alaska and the Caribbean. The Otter is the subject of this week's drawing (R.C.A.F. machine shown). A recent modification is the fitting of a pair of simple wing fences; unusual on a "straight-wing" aircraft, these improve low-speed behaviour.



CANADIAN OIL SEARCH

AIRCRAFT are being employed extensively in the search for oil in Canada. At least three air-survey companies are (or have recently been) using magnetometers and other instruments in the search for natural resources in Labrador, the northern wastes of the Provinces, the Northwest Territories and Yukon Territory. From Ottawa, Government departments are directing the work of "oil search wings" of fixed-wing aircraft (Bellancas, Norsemen, Cessnas, Stinsons, Beavers, etc.) and helicopters. These machines operate from centres like Yellowknife, main base for exploring the heart of the Northwest Territories; Norman Wells, in Arctic Canada; and Whitehorse, the capital of the Yukon.

The major oil companies, including Shell, Imperial and Standard, have been making round-the-year oil surveys of the Northlands, using helicopters, light aircraft (fitted with wheels, skis or floats, depending on the season and on the territory) and, where there are landing facilities, DC-3s. Free-lance prospectors, including the "go-anywhere" bush pilots, are also taking part in the search.

The usual drill is for geologists to use a key airfield as a base from which to prospect outlying areas. C.P.A. and Associated Airways are available to fly personnel to these termini, from which quartering flights are made into the interior by bush-plane. In winter, drilling-gear may be delivered to likely areas by sledge-trains hauled by half-track vehicles, or by aircraft if there is a frozen lake or river near; or men may be landed by light aircraft to build airstrips for the delivery of heavy drill equipment. Bush-planes are also employed in winter to lay fuel dumps in remote localities for use the following spring.

The first important oil operation in the area was that at Norman Wells, on the Mackenzie River in the N.W.T.; it was linked by the Canol Pipeline to the Alaska Highway and the airfields of the war-time north-west staging route to the U.S.S.R. An aviation-spirit refinery was actually built at Whitehorse as part of the Canol project, to supply aircraft being flown up the staging route to the U.S.S.R. More recently, the major oilfield north of Alberta was surveyed by air, as was the case with the important new oilfield found in the "wilderness country" flanking the Alaska Highway and described by the Prime Minister of British Columbia as "second only to the Alberta oil-strike."

Last summer the search was extended. It has continued throughout the winter, with aircrew and oilmen prepared for temperatures of 60 and 70 below zero.

At the top of the page are two pictures of historic value: the war-time Canol pipeline and, right, a fleet of early Fairchild 71s operating from the lake at Yellowknife, now being used as an oil-search base. Other views show an Associated Airways Bristol Freighter on a supply trip into the Northland; an oil-survey party being flown-in by Beaver; and another party—with one member traditionally attired for the job—at work with the aid of a Bell 47 helicopter.

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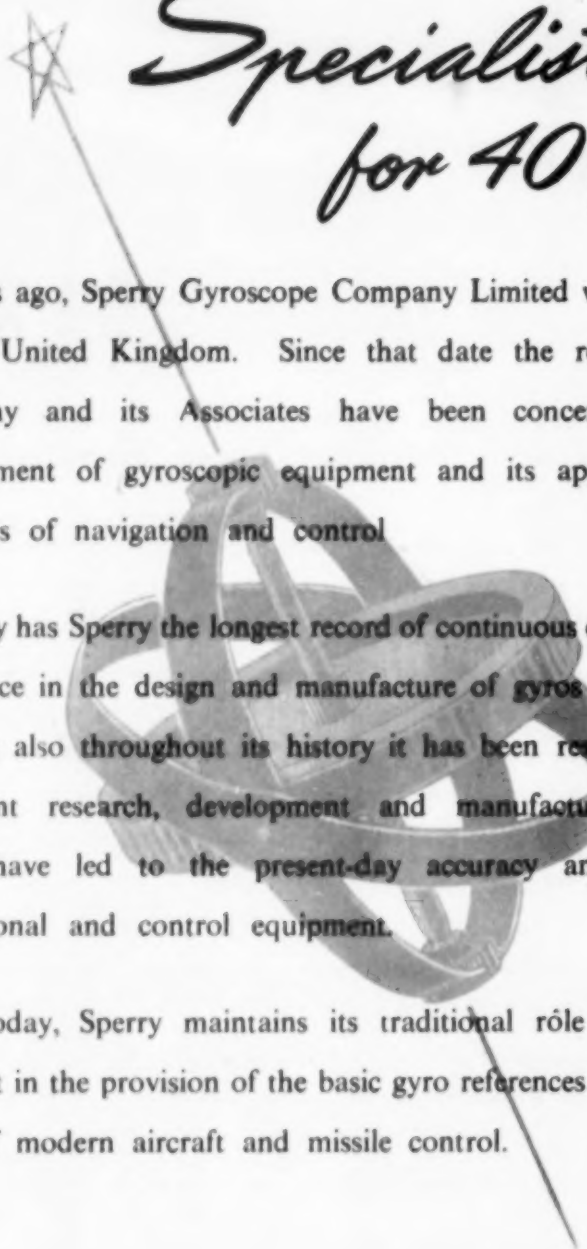

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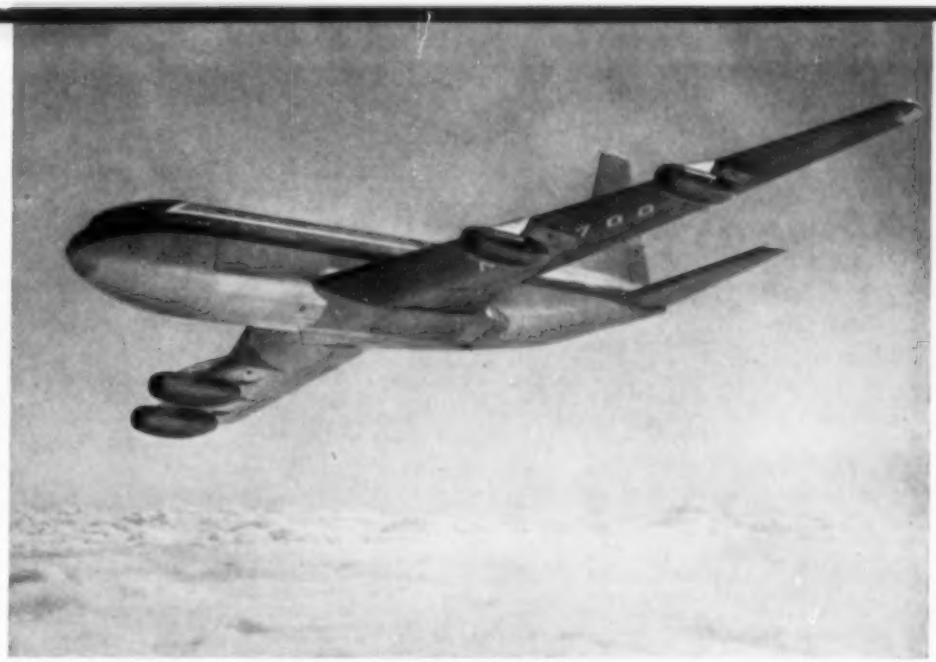

An exhilarating picture of Boeing's contender in the jet-transport field. Design experience on the 707, with special reference to cabin pressurization and general safety features, formed the basis of the two technical papers reported below.

High-altitude Transport Problems

Two Boeing Papers from the I.A.S. Annual Meeting

AMONG the 77 papers presented at the 23rd annual meeting of the Institute of the Aeronautical Sciences in New York last month were two, by engineers of the Boeing Airplane Company, which provide significant detail of present American thought concerning high-altitude transport aircraft. The main points from these two lectures, which concern cabin-pressurization design criteria, and design safety aspects of the Boeing 707 respectively, are reported on these pages.

THE paper *A Review of High Altitude Cabin Pressurization Design Criteria as Related to Future Transport Operations* was presented by Mr. L. M. Hitchcock, staff engineer (structures) of the Boeing company. He began by emphasizing that the increased true airspeed of the "next generation" of transports would be achieved for a relatively small increase in indicated speed, which was the primary cause of all air-loads on an aircraft. This was one of the advantages of using a higher operating altitude. The trend of the design differential-pressure requirements over the last 18 years showed that the jet transport was no departure from an orderly development in this field.

Turning to the various types of damage which had been responsible for pressure-cabin failures or might be considered to have a probability of occurrence, Mr. Hitchcock listed punctures appearing in flight, damage occurring on the ground, defects in manufacture or quality of maintenance, and material fatigue.

One of the causes of in-flight damage in the past had been the puncture of pressure cabins by broken airscrew blades. Punctures might also be incurred by the loss of jet-engine compressor or turbine blades, or of cowlings, fairings, aerials or access doors. It was unlikely that the possibility of this type of failure could ever be entirely eliminated. Severity had varied from rapid decompression when an airscrew failure caused the loss of a large portion of the cabin roof, to instances where small holes were made with resultant leakage no greater than that for which the cabin pressurization system could compensate. There were no known instances of the loss of an aircraft from these reasons.

On the ground, careless use of ground-handling equipment could produce damage which might not be reported or even discovered; in addition, rocks, ice or foreign objects could be thrown up by the wheels during taxying or take-off. Such damage might not be a great service problem but must be considered in the design to preclude the possibility of serious consequences during pressurized flight.

The possibility of improper manufacture and maintenance must also be assumed. It should be considered that sub-standard repairs or modifications might be made to transport aircraft during their service life, and it was also conceivable that instances of corrosion might not be discovered.

An important problem, currently of tremendous interest and concern, was that of fatigue. A fundamental concept of safe design should recognize that a transport aircraft, with proper maintenance and replacement of parts, would last indefinitely. Experience indicated that cracks had occurred and might be expected to occur during the service life of an aircraft. A pressure cabin of an aircraft was a complex structure having many areas of load concentration with the accompanying potential stress-concentration: provisions for the proper load re-distribution around windows, doors and other cut-outs and discontinuities were made with extreme care in order to prevent any undue stress-concentration.

The effects of secondary deflections and the variations of stress concentration in joints, splices and reinforcements were also given careful design consideration, since it was realized that detail design was a most significant factor and was all-important to fatigue life. Yet, in spite of all these precautions, it must be recognized that cracks might occur in the pressure structure, and laboratory tests would not preclude this possibility.

In the initial design there were many environmental conditions in pressure cabins which could not be accurately accounted for or tested. These included such factors as jet-efflux effects, induced thermal stresses, airscrew buffeting and flight-load effects. Some areas of the pressure-cabin skin would be quilted under load, and

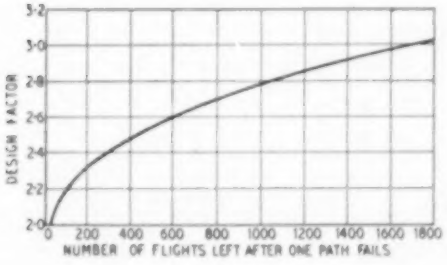

Fig. 1. Dual-load-path life after first failure (24S-T3 material, assumed static strength 50,000 lb/sq in).

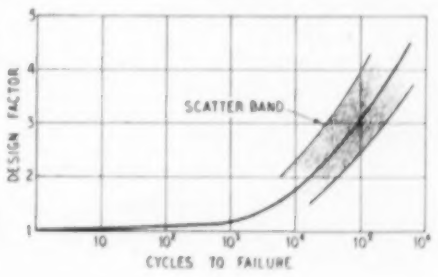

Fig. 2. Design factor plotted against fatigue life (24S-T3 fuselage joints, stress range zero to maximum stress).

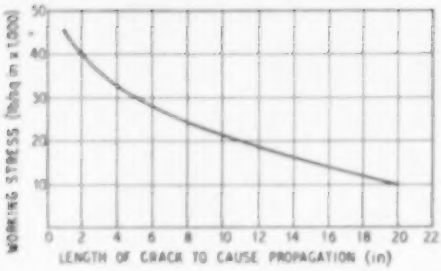

Fig. 3. Stress level against tear resistance, for 24S-T3 material, based on tests forming part of a current Boeing programme.

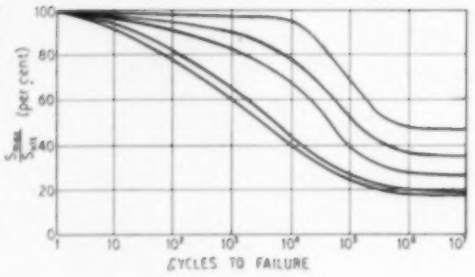

Fig. 4. Fatigue life variations within composite structures (for 24S-T3, zero minimum stress).

HIGH-ALTITUDE TRANSPORT PROBLEMS . . .

these deflections might or might not cause unsuitable aerodynamic forces or buffeting.

"Another factor of importance," the lecturer continued, "is the well-known large scatter in fatigue life, although there is some evidence to indicate that this scatter may not be as great for full-scale structural sections as exists in small laboratory specimens. This scatter can be influenced considerably by differences in operating procedures of the various airlines, because of variation in routes, trip lengths, type of weather, speeds, and pressurization procedures. Scatter can be further affected by variations in manufacturing quality during the fabrication of a transport and/or by repairs and modifications after the airplane is delivered to the operator. It is therefore impossible to assign a number to the point at which fatigue cracks will begin to appear. There are instances in the past when full-scale fatigue tests were run and complete reliance on airplane-life predictions placed on the results, yet the airplanes so tested suffered most unfortunate accidents from fatigue. There is no reason to believe that complete reliance on airplane-life predictions based on analysis and testing can be made in the future any more than in the past."

The pressure-cabin design criteria which should be adopted to achieve the goal of safety in spite of damage must obviously include the requirements of multiple-path structure. It was also evident that the pressure structure must provide a high level of tear resistance against possible damage, consistent with the design and operating pressure loads. The design criteria should also include requirements providing both a high level of fatigue endurance for the overall structure sufficient to preclude abnormal maintenance requirements, and an adequate fatigue endurance after a partial failure to provide reasonable time in which to discover the damage. The general level of endurance should be at least comparable with that of successful past transports.

The main design criteria used by the Boeing company were:—

(1) Multiple-load-path structure was used around cut-outs and other areas of load concentration.

(2) A safety factor of three was applied to the maximum operating pressure in these areas of load concentration, so that a factor of the order of 1.5 would exist if one member of a dual-load-path structure failed. This would provide a good level of fatigue life for the overall structure and give adequate time for discovery of a possible partial failure (see Fig. 1).

Design factors of safety must be selected to ensure a constant level of endurance in the other areas where no load concentrations were believed to exist. For a typical longitudinal fuselage-joint (as indicated in Fig. 2) a safety factor of 2.5 could provide a high level of fatigue endurance. It would be desirable for a new design to be based on the established level of fatigue endurance in a previously successful design. When pressure was combined with general flight loads a reasonable criterion was believed to be a factor of safety of two on the maximum operating pressure combined with a factor of safety of 1.5 on the most critical flight-loads that were consistent with this pressure.

(3) Tear-resistant structure capable of limiting the effect of local damage should be employed. Most modern transport aircraft were of the "skin and longitudinal stiffener" type of construction and were believed to be more tear-resistant for longitudinal stresses than for the hoop stresses, since the longitudinal pressure loads were one-half the hoop pressure loads and there was more multiplicity of structure for the former loads (see Fig. 3).

(4) Dual safety of windows should be provided for high-altitude operation where window failure could be critical. This could be accomplished by two separate windows of acrylic or glass, or by the use of laminated-glass windows where the vinyl inner layer was the secondary-pressure-carrying member in the event of the glass failing.

(5) Doors, windows and escape hatches of the plug type in which pressure forces held them in place were desired where possible. This eliminated dependence upon hinges and latching mechanisms which were subject to fatigue failure or malfunctioning.

(6) "Design against fatigue" must be one of the major criteria used during the detail design.

"After the design criteria to assure safety and endurance of pressure cabins have been established," Mr. Hitchcock went on, "a comprehensive test programme must be conducted to demonstrate that the design criteria selected have been met. Common industry practice for a number of years has required fatigue tests of typical skin splices and joints of stiffeners and frames. Such tests were essential early in the design to establish that generally a high level of endurance of the basic structure existed. Repeated-pressure-load tests of windows, hatches, doors, and surrounding structure have been considered to be general practice in establishing the design excellence of cut-out areas. It has also been a general industry practice that the fuselage, or a representative segment thereof, be tested to an ultimate factor of 2 times the maximum normal operating pressure.

"In light of recent service experience and considering the consequences of failures of high-altitude pressure-cabins, it is believed that additional tests on composite pressure-structures should be conducted to show that pressure-structures are satisfactory, even though an extreme effort has been expended during the detail design to provide assurance of structural integrity. In the past, reliance upon ultimate-strength tests of airplane components has been used in many cases as a measure of structural adequacy. Service experience has shown many cases where components of an airplane have satisfied ultimate-load tests only to experience fatigue damage after relatively few hours of operation. This is readily explained by the effects of the varying amounts of stiffness occurring at joints and cut-outs, as well as the effects of stress-concentration factors. Individual parts of a composite structure may have the large variation in fatigue life shown in Fig. 4. However, in static test of the composite structure this variation in the strength of individual parts is not apparent because of local yielding at points of high stress, and the point of static failure may have no relationship to the results obtained from fatigue tests. It is therefore believed that cyclic-pressure tests must be conducted on a composite pressure-structure to establish the structural ruggedness of a pressure cabin. It is recognized that each detail of a composite structure has its own individual S-N curve, and fatigue tests must include representative areas of critical portions of the structure. It is also believed necessary that tests be conducted to determine the effect of punctures, tears, or fatigue cracks on such structure while under pressure. The following tests are believed by Boeing to be necessary to assure a sound pressure-structure for high-altitude operation:—

"(1) Critical areas of a complete pressure-cabin should be carefully checked to determine the magnitude of stresses under pressure. This can be accomplished by use of strain gauges, stress-measuring paints, or other suitable devices. Such a test program will give some early indication of areas of concern and what steps should be taken to reduce any high stresses which may be observed.

"(2) Since it is now generally agreed that repeated-load tests should be conducted on all critical areas of an airplane, this must also include the pressure-structure. For a wing, which today has relatively few cut-outs and areas of load concentration, it is believed that critical joints, splices or other areas can be fatigue-tested in the laboratory with good representation. However, pressure-cabins have many cut-outs and areas of load concentrations. It is difficult to simulate all the critical areas satisfactorily, other than by pressure-cycling a section of the pressure-cabin itself. The extent of this test specimen must be determined by reviewing all the critical areas and making sure that representations of those areas are included in the specimen. This cyclic-test section should be large enough to contain at least representative specimens of all questionable areas. In some instances it may be desirable to use a complete fuselage. These tests must not be considered as establishing the actual number of hours of fatigue life but rather that the failures that do occur will not propagate seriously before being discovered. They will point out the critical areas, the type of failures resulting, and the

necessary inspection procedure for the operators to follow.

"The tests should be conducted until many failures have occurred in the specimen and they have been revised to the point of achieving a long life, or until such a large number of cycles have been sustained that it appears reasonable to stop.

"(3) Tear-resistance tests should include the puncturing of various portions of the pressure-cabin while under pressure with holes simulating the level of damage of the design criteria. These should be conducted on the full-scale test specimen. The pressure selected for the tests should simulate the operating condition.

"(4) It has been Boeing practice to proof pressure test each transport airplane to 1.5 times the maximum operating pressure before delivery. This provides assurance of proper installation of all doors and windows and that all seals are satisfactory."

It was believed that such a test programme would provide a real assurance of sound cabin-design, although it remained possible that fatigue cracks might occur in areas other than the critical ones examined.

"After delivery of the airplane," the lecturer concluded, "the control of damage to the structure and the maintenance of safety and endurance is logically the responsibility of the operator. The manufacturer recognizes his responsibility to provide guidance to the operator during the initial service period, utilizing the development-test results for the specific airplane and experience gained from previous airplanes. In addition, continuing co-ordination is necessary between the manufacturer and the operator after the initial service period in order to modify inspection and maintenance procedures as will be indicated by the service experience on the airplane. The extensive knowledge of structural details, design considerations, and test results possessed by the manufacturer when combined with an aggressive and alert inspection program by the airline operator will produce a level of safety above question."

DESIGN SAFETY ASPECTS

A PAPER entitled *Design Safety Aspects of the Boeing 707 Jet Transport* was presented by Mr. E. W. Norris, Boeing airworthiness engineer. In his introduction he suggested that the safety of aircraft should not be measured by the number of safety devices provided, but that safety systems, procedures and devices should be considered as necessary compensations for undesirable characteristics which the designer had not been clever enough to avoid.

One of the greatest single contributions to safety in the Boeing 707, the speaker continued, derived from the operational simplicity of its power plant. Each of the J 57 engines was operated by a single lever, mechanically connected to a hydro-mechanical regulator on the engine. There were no controls for airscrew pitch, mixture, cowl flap, carburettor heat, supercharger, airscrew synchronizer and other devices. By comparison, the 707 had 115 fewer powerplant controls and displays than a Stratocruiser.

Accident studies indicated that cockpit work-load was highest in going around again after a missed I.L.S. approach. Among the factors which reduced the work load under this condition in the 707 were (1) the approach angle was controllable by speed-brakes; (2) the single power-adjustment motion; (3) the absence of any airscrew adjustment and (4) the absence of any aircraft control problem, since longitudinal trim varied with speed and not with power.

Primary flight controls of the 707 were all 100-per-cent manually operated, and no power assistance was provided. In the interests of simplicity, reliability and safety these controls were all actuated by spring tabs connected by cable to the pilot's wheel and rudder-pedals. The use of internal pressure balancers permitted tailoring of the system to give low control-forces at low speeds, for good manœuvrability, and higher forces at high speeds where abrupt manœuvres were undesirable. This, Mr. Norris claimed, gave the systems an optimum natural feel and avoided both sluggishness and over sensitivity.

Lateral control was obtained by mid-span, high speed ailerons supplemented by hydraulically operated spoilers and, when flaps were down, by outboard or low-speed ailerons. This arrangement enabled the aircraft to develop a rate of roll (flaps up or down) considerably higher than typical conventional transports and ensured excellent lateral control on landing. The 707 could operate safely with a 90 degree crosswind of 30 m.p.h.

The spoilers could also be used symmetrically as speed-brakes, to facilitate emergency descent or to correct a high or fast approach. This gave the pilot a wider choice of approach angles than was available in most piston-engined aircraft. Spoiler actuation by hydraulic pressure was controlled by a single lever on the control pedestal, arranged for convenient operation with the throttles.

The use of spoilers on touch-down helped to unload the wing and place more weight on the wheels. By the resulting increase in braking effectiveness, landing distances could be reduced by 15 to 25 per cent. Spoilers used as speed-brakes were also very effective in decelerating the aircraft when rough air was suddenly encountered in flight.

The speaker turned next to some structural features of the 707. The possibility of cabin decompression had been minimized by the use of conservative safety factors, meticulous detail design, multi-path structure (including windshield and windows) and by provision of simple plug-type doors. Hazards of rapid decompression through a window (which required dual failure) were minimized by increasing the time of decompression in two ways: small windows were used and an extremely high rate of emergency descent was possible.

One point of popular concern, the lecturer continued, concerned the effect of atmospheric gusts and turbulence upon the aerodynamically clean jet transport. The wing of the 707, which was swept for other reasons, had an inherent aeroelastic characteristic which combined with sweep to reduce the effect of gusts upon wing-loading. On striking a gust, the wing bent along its elastic axis, causing effective wash-out of the wing-tips. The wash-out relieved the loading and reduced wing bending to minimize the effect of the gust. Thus automatic compensation was provided for this anticipated hazard of high-speed flight, and the possible need for an elaborate gust-alleviation device was avoided.

The hazard of engine fire had been reduced by the isolation of the engines from the wing structure, due to the pod installation, and this was supplemented by judicious use of fireproof materials, fire detectors, adequate shut-down provisions and good drainage of combustible fluids. In the event of fire-warning, a light was illuminated in the handle of the single fire-switch provided for each engine and prominently located in front of the pilots. Operation of the switch simultaneously isolated the electrical and fluid systems of the appropriate engine at the wing. The Boeing company's experience with pod-mounted turbojets and nacelle-mounted piston engines, incidentally, indicated a reduction of about 60 per cent in fire rate for the turbojet.

Concerning operating safety characteristics, as the 707 was intended to operate from existing airports the design had to be based on moderate wing-loading and thrust-loading. These features contributed towards an increase of nearly 40 per cent over the take-off acceleration of an aircraft such as the Stratocruiser. Obviously this increase in acceleration could be converted into an increased rate of climb, or angle of climb, as the pilot wished.

"Despite a rather unfortunate and embarrassing experience to the contrary," Mr. Norris continued, "the problem of stopping a large jet transport airplane need not present a problem of the magnitude originally anticipated." Approach and landing speeds of the 707 compared closely to those of advanced contemporary piston-engined transports. The landing field length difference between piston-engined and jet transports amounted to the effect of windmilling airscrew drag during the landing run; the absence of airscrew drag on the 707 could be compensated for by the use of speed-brakes.

Although landing field lengths had been based on no reversing thrust, it was planned that reversing would be available as an added safety feature of the 707. Effectiveness of this device was expected to permit the realization of dry runway landing distances under icy surface conditions. Again simplicity and reliability of the system would be stressed, but analyses of failure indicated that malfunction or failure of the jet reverser would be less hazardous than airscrew malfunction in conventional aircraft under the same circumstances.

Ditching was a remote but proven hazard which must be considered when aircraft were involved in over-water operation. A review of accidents involving ditching of conventional four-engined airscrew-driven aircraft indicated that a principal cause was the inability to develop adequate performance in two-engine-out emergencies. Adequate two-engine performance for piston-engined aircraft was available only over a narrow range of speed, while, by contrast, the jet transport had a better *en route* climb ability on two engines and it could maintain its advantage over a very broad speed-range.

The safety problems in jet transportation were essentially the same as those in conventional types of transport aircraft. The higher cruising speed and higher operating altitude of the jet would increase the problem of mid-air collisions as traffic at these altitudes cruised. Though the speed increase was not apparent in the terminal areas where traffic was greatest, the rate of closure of two jet aircraft at cruising altitude made more urgent the development of collision-warning equipment and continuous traffic-control systems. The accuracy of existing altimeters at high altitudes must be improved or altitude separation between aircraft increased.

Although not directly a safety problem, fuel reserves would be influenced by the accuracy of high-altitude wind information. An improvement in the accuracy of forecasting and the speed of reporting winds aloft was certainly indicated.

"Since these problems do apply in large measure to existing aircraft," the speaker concluded, "they are under constant attack by appropriate government and industry groups. Solutions satisfactory for all types of aircraft are anticipated prior to the time of introduction of jet transports such as the 707."

At an R.A.F.G.S.A. inter-club rally at Lyneham last summer. A Gull IV, Weihe, Tandem Tutor and Sky are among the aircraft.

SERVICE GLIDING and SOARING

—*as a Sport: Some Thoughts on the R.A.F.G.S.A.*

By KENNETH OWEN

AN air-minded visitor from another planet—or from France—would certainly be surprised on arrival in this country at the lack of financial encouragement given to any form of flying as a sport. If he were sufficiently naive as to expect enthusiasm for the sport in the Ministries and Services concerned with the air, then the wall of official apathy—or, at best, of toleration—against which British enthusiasts have banged their heads so often, would come as a great shock.

The object of this article, however, is not to discuss the merits and demerits of possible Government support for gliding or powered flying, interesting as that subject is, nor to point to the lack of logic in the present national situation. It is to look at sporting gliding in the R.A.F. in relation to the national picture, to discuss some of the activities of the member-clubs of the R.A.F. Gliding and Soaring Association, and to add a few personal comments on the present position of sporting flying in a flying Service.

There are three forms of gliding which take place under R.A.F. auspices. Under Home Command comes Air Training Corps gliding, in which A.T.C. cadets receive elementary training on gliders owned by the Service and financed from public funds. The stimulation of recruiting appears to be the main purpose of this scheme, under which a large number of cadets are each given a small amount of training. Secondly, the gliding hours flown by Service cadets and apprentices at Cranwell and Halton are also performed in R.A.F. machines and at public expense.

A visitor to the R.A.F.G.S.A. Lyneham rally was the E.T.P.S. Sky, which headed the team class in the 1953 British Nationals.

The third aspect of Service gliding, the sporting aspect, is the responsibility of the member-clubs of the R.A.F. Gliding and Soaring Association, which is financed entirely from non-public funds and the pockets of club members. The Association itself receives a small annual payment from the R.A.F. Sports Board, plus membership fees from clubs and individuals. From the money provided by the Sports Board an annual subsidy is paid by the Association to each club in this country, broadly on the basis of the number of hours flown by the club during the previous year.

There are at present eight U.K. clubs belonging to the Association, at Middleton St. George, Feltwell, Lyneham, St. Athan, Biggin Hill, Boscombe Down (now moving to Andover), Scampton and Little Rissington. (The last three of these are to enter teams for this year's National Gliding Championships, the Little Rissington entry being captained by A. Cdre. G. J. C. Paul, D.F.C., the Association's chairman.) In addition there are clubs at R.A.F. stations in the Middle East, while the R.A.F. in Germany has its own Association of 2nd T.A.F. Gliding Clubs, in both cases associated with the R.A.F.G.S.A.

An indication of the extent of the Association's activities was given at its annual meeting in London last month. Statistics showed that last year some 9,500 launches were logged, an increase of 2,000 over 1953, and average membership over the year had increased to 500. In addition the 2nd T.A.F. clubs in Germany had achieved over 15,000 launches.

The enthusiasm of the members of the G.S.A. clubs needs no explanation for anyone who has himself known the unique feeling of soaring flight. But what of the philosophy behind the encouragement of such activities in the R.A.F.? Why is it necessarily a good thing to have Service gliding clubs?

Again, to those bitten by the gliding bug, the answer is obvious. But it is as well to mention a few aspects of this philosophy which do not depend on personal experience and which are relevant and important. The fact that they are so often ignored by those who regard flying and gliding as things apart—and who really should know better—is a matter of extreme concern.

The acute problem facing the R.A.F. today, and which is doubtless a major cause of recruiting difficulties, is that the technical and administrative manpower required to operate and maintain aircraft is so great that the persons who fill these posts can see no connection between their duties and flying. In the past, when the Service flew simpler and less expensive aircraft, it was common for every man on the station to have the opportunity to fly. Nowadays Service flying is a formal and costly operation involving much preparation and complicated machinery and, inevitably, many R.A.F. men are out of touch with it.

To correct this lack of contact between flying and those who are airmen only in name is the primary purpose of the Gliding and

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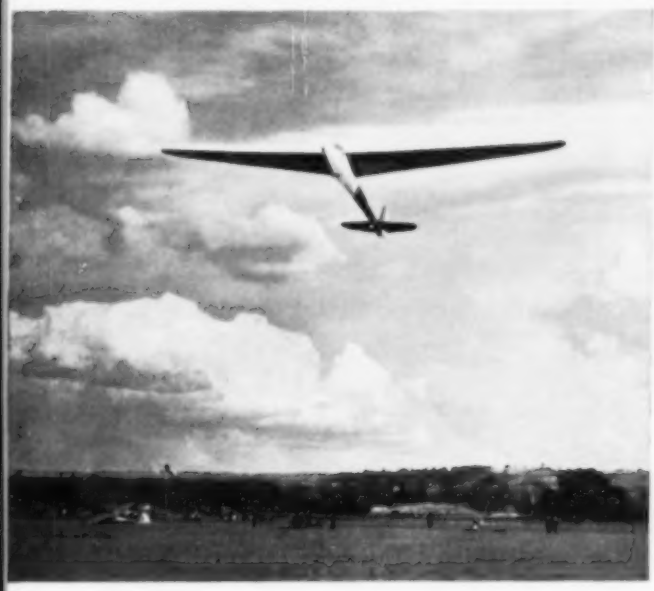

The German-built Weihe operated by the Little Rissington club. Only four high-performance sailplanes are at present owned by the Royal Air Force Gliding and Soaring Association.

SERVICE GLIDING AND SOARING . . .

Soaring Association. There is a parallel case in the Royal Navy where, with increasing size and complexity of ships, basic seamanship has become remote from the vast majority of sailors. Nevertheless, nearly all ranks in the Navy are trained in the rudiments of seamanship. In the R.A.F., those wanting to learn the rudiments of airmanship are forced to fight hard to obtain facilities eagerly given to football, hockey, tennis and other teams. This fierce enthusiasm for ball-games coupled with an apathetic toleration of flying is quite an interesting phenomenon—particularly in some of those who guide the modern Air Force. It is not a matter for congratulation.

Sporting flying, of course, does not have to be gliding. The formation of powered light-aircraft clubs would be equally useful in providing flying for those who do not normally have the chance of getting into the air; indeed, the existence of both gliding and powered-flying clubs in the Service is extremely desirable. However, the difficulty of forming a group to operate light aircraft in the R.A.F. (or, for that matter, in civilian life) remains great, mainly due to expense.

Incidentally, the first light aircraft flying group in the R.A.F. was formed only last year, with the encouragement of the Popular Flying Association. A second R.A.F. group has since commenced operation and others are in the process of formation—a highly promising tendency which, if the Service is not careful, may lead to still more of its members becoming keen on flying.

Gliding and ultra-light powered flying have much in common, and yet gliding remains at once the more difficult and more rewarding. Only by understanding the atmosphere in which he flies can the glider pilot remain airborne: other things being equal (which, of course, they rarely are) the quality or duration of a flight depends directly on the pilot's skill. While to some it might appear more "useful" to drive an engine with wings from A to B, there remains something natural, or certainly less unnatural, in using only the wind and the sun and a pilot's knowledge of the air.

Skill and precision in the arts of piloting, navigation, landing, and aerobatics, if one likes that sort of thing, are common aspects of both powered and soaring flight. But few would disagree that gliding requires—and gives in return—something extra. Not only is skill required and satisfaction given in the air, but there is also the value of teamwork on the ground. Again there is a nautical analogy—that which exists between yachting and motor-boating. The aeroplane is a transport vehicle; the sailplane, aviation's yacht.

These thoughts are not intended as propaganda for gliding. They are intended to suggest a rational reason why active Service support should be given to what is an airman's sport in the truest sense of the term. To those who think that sufficient support is already given, one might ask by what piece of logical reasoning the transport charges for a gliding occasion may amount to, say, £5, while the same journey would have cost only 5s had the object been swimming, or shooting, or kicking or throwing a ball around a field. No reasonable person expects Services accounts to be simple, but this seems particularly ridiculous. One wonders why gliding is regarded as a sport by the Sports Board and not by the auditors.

As any future expansion of gliding depends on adequate transport, the fact that no vehicles are supplied and that high rates are charged are serious problems. Another problem is that of servicing, which is at the present performed entirely by gliding members in their own time and using materials bought at the club's expense. Here also the Service could show a more realistic outlook.

Co-operation with the B.G.A. Throughout its five-year life the R.A.F.G.S.A. has worked closely with the British Gliding Association, of which it is a full member. One member of the G.S.A. Committee, at present S/L. H. Neubroch, represents the R.A.F. clubs on the council of the B.G.A., and there has been keen R.A.F. participation in the last three National Gliding Championships.

The R.A.F.G.S.A. gliding scholarship scheme, introduced last September, was the outcome of efforts to link the Association even more closely with the B.G.A. Under this scheme, gliding is made available to Service personnel based on stations not possessing their own gliding clubs but within reach of a civilian club.

Any member of the R.A.F. can apply for a gliding scholarship. If he or she is not already a member of the R.A.F.G.S.A., application for membership can be made when applying for the scholarship. If successful, the applicant joins a civilian club, paying entrance fee, subscriptions and flying charges himself in the first instance. The G.S.A. will then refund the first 2s 6d of the cost of each launch, the first 10s of the flying and retrieving fees payable for each flight and, after candidates have completed 50 hours' flying, all entrance fees and subscriptions they have paid.

At the time of the Association's annual meeting last month, 12 scholarships had been awarded. With the beginning of this year's season and the appearance, one hopes, of good soaring weather, this rate will almost certainly increase: a total of 50 scholarships is available for the first twelve months of the scheme.

This development is undoubtedly an important one, having a twofold beneficial effect in making gliding available to more members of the Service and bringing closer together the R.A.F.G.S.A. and the B.G.A.

With the French Service de l'Aviation Legère et Sportive, also, the G.S.A. is in close touch. Under a special arrangement, selected club members are able to visit certain soaring centres in France at a nominal cost, apart from fares, each year—a facility greatly envied by civilian club members in this country.

The Future. The one aim of the Association, as given in its constitution, is "to bring gliding and soaring within the reach of all members of the Royal Air Force, with special regard to those normally employed on the ground," and progress is indeed being made towards this aim.

Few will deny the value of soaring to R.A.F. pilots. The basic knowledge, which gliding and soaring gives, of how the air behaves, must increase any pilot's understanding of the medium in which he operates, with benefit to himself and the Service. But the numbers involved here are relatively small. (Another incidental point is that the object of the R.A.F.G.S.A. is certainly not to train club members as military pilots.) It is to the man on the ground that gliding has most to offer—and it is from the participation of those on the ground that the Service itself has most to gain.

I have suggested in this article that R.A.F. gliding as a sport merits more interest and active support than has been shown up to now by the Service authorities. The first requirement is simple enough. It is that the principle should be accepted that gliding and soaring are somewhat more beneficial means of encouraging an interest in flying among R.A.F. ground trades than kicking, throwing or chasing a ball, or causing violent bodily injury to a member of one's own Air Force in a boxing ring, or other such pursuits. The second requirement is that someone should point out to someone that an interest in flying is a Good Thing.

Once these ideas (surely not really revolutionary?) are accepted, details can be investigated. It has been suggested that airmen passing out at the top of technical and administrative courses should, if fit, be given a short flying course at one of several R.A.F. gliding centres, possibly based at the Elementary Flying Schools. Another proposal is for combined gliding and powered-flying clubs, still on a spare-time basis. A third envisages one permanent R.A.F. advanced soaring centre. And these are not the only possibilities.

But before such schemes can be launched with any prospect of success, the basic change in attitude mentioned above is essential. The R.A.F.G.S.A. and the B.G.A. are together doing more than any other organizations today to foster the air-faring outlook in this country. The Services contribution could be so much greater, given half a chance.

THE AERONAUTICAL BOOKSHELF

"Aerial Propaganda Leaflets," by John C. W. Field, F.R.G.S., Francis J. Field, Ltd., Sutton Coldfield. Illustrated. Price 10s. 6d.

PRODUCED by a firm which specializes in books on airmail postage for stamp collectors, this is one of the most unusual publications to come our way for a long time and will itself almost certainly be a collector's item one day.

As well as cataloguing all known air-delivered propaganda leaflets, it includes a history of their use and articles on subjects ranging from "Aspects of Psychological Warfare" and "Making and Arranging a Collection" to a description of a wartime R.A.F. "bomphlet" raid.

Many readers will be astonished to learn that leaflets were sent by air as early as A.D. 549, when a besieged city in China flew out messages of distress by means of kites. Propaganda leaflets appeared in the Middle Ages, when scrolls containing messages were wrapped around the shafts of arrows and fired into besieged castles. But it is the incredible number and variety of leaflets dropped in our own time that will most surprise the uninitiated.

They include ribald pictures of Hitler in a Viking helmet and lifebelt, "marching against England"; safe-conduct passes showered on enemy forces everywhere from Normandy to Korea and Kenya; "Save Waste Paper" campaign leaflets; and even forged ration papers and bank notes. The value of the leaflets today ranges from £7 for a note delivered by V.1 flying bomb to a humble three-and-sixpence for one designated to persuade the people of Rome to vote for the Italian Social Democrat Party in the 1952 elections.

"Glass Reinforced Plastics," edited by Philip Morgan, M.A. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Illustrated. Price 35s.

IN this essentially practical review (compiled by the Editor of *British Plastics*) of the various forms and applications of glass/resin laminates, one section is devoted to the use of such laminates in the aircraft industry. In this chapter, Richard Wood writes in some detail of the methods employed in the production of aircraft components such as radomes and ventilation ducting, and refers to the recent and significant application of glass reinforced laminates to aircraft tools (notably drill jigs and trim templates).

Another chapter, *Design and Properties of Structures*, is by Lorne Welch, who is at present a technical officer of the National Research Development Corporation. The remaining sections of the book include descriptions of the properties of the resins used, production processes, and applications of the laminates to the electrical, automobile and boat-building industries.

"Proceedings of the Toronto Meteorological Conference 1953." Published by the Royal Meteorological Society, 49 Cromwell Road, London, S.W.7. Illustrated. Price 30s.

THIS volume, recording the papers presented at an important meeting of British, Canadian and American meteorologists, includes a section on high-level forecasting. In this, *Jet Streams in Middle and High Latitudes*, by D. P. MacIntyre and R. Lee (Meteorological Service of Canada), concerns a study of winter jet streams over North America in various stages of their history; *Observations on Billow Clouds and Deforming Exhaust Trails from Aircraft*, by R. C. Bundgaard (Air Weather Service, U.S. Air Force), describes evidence concerning small turbulent disturbances in the upper troposphere, obtained from stereophotogrammetric observations of aircraft exhaust trails; and in *Jet-stream Detail with Respect to Other Meteorological Factors*, by S. Teweles, Jr. (U.S. Weather Bureau), the association of 300-mb isotach patterns with certain frontal patterns has been examined with a view to providing models useful in 300-mb analysis for areas of adequate surface information but scarce upper-level data. A report on an empirical study of high-level aircraft encounters with clear-air turbulence over the eastern half of the United States during a period of one month is given by Le R. H. Clem (U.S. Weather Bureau) in *Clear-air Turbulence at High Levels*.

"Limitation of Liabilities in International Air Law," by H. Drion. Martinus Nijhoff, The Hague. Price 24.5 guilders.

THIS book is the result of work done at the Institute of Air Law of McGill University and at the Harvard Law School, and constitutes the first study entirely devoted to the air carrier's or operator's liability under the Warsaw and Rome Conventions. It forms a useful guide to the differences and similarities between these conventions, the provisions of which are discussed not in separate sections of the book but in parallel, in connection with the treatment of each liability problem in turn. Since private international law is grafted upon national laws, attention has been given to the provisions of national legal systems, including those of Britain, U.S.A., France, the Netherlands, Italy, Germany and Latin American countries. The texts of the Warsaw Convention and of the 1952 Rome Convention are given in annexes, and there is a table of some 330 cases.

"The Testing of High-Speed Internal Combustion Engines" (4th Edition), by Arthur W. Judge, A.R.C.S., D.I.C., Wh.Sch., A.M.I.Mech.E., A.M.I.A.E. Chapman and Hall, Ltd., 37 Essex Street, London, W.C.2. Illustrated. Price 75s.

IN this fourth edition of what has become a standard work, much new information and data have been included: in particular, the section dealing with methods of measurements of brake horsepower has been expanded, and there is an entirely new section devoted to the subject of testing aircraft gas turbines, whilst the previously published account of aircraft piston-engine testing has been revised and brought up to date. The book now contains nearly 400 illustrations.

OTHER BOOKS RECEIVED

A Dictionary for the Forces, English-French; French-English, by Pierre F. Cardi. George Allen and Unwin, Ltd., Ruskin House, Museum Street, London. Price 10s 6d.

Air War Against Germany and Italy 1939-1943, by John Herington. Angus and Robertson, 105, Great Russell Street, London, W.C.1.

Swooping Vengeance and *Shattering Silence* (two adventure books for young people, with an aeronautical flavour), by Geoffrey Dorman. Hutchinson and Co. (Publishers), Ltd., Hutchinson House, London, W.1. Price 6s each.

The Mint, by T. E. Lawrence (352087 A/C. Ross). Jonathan Cape, 30 Bedford Square, W.C.2. Price 17s. 6d.

Annual Report of the Board of Regents of the Smithsonian Institution (year ended June 30th, 1953). Published by United States Government Printing Office, Washington.

The Royal Air Force Medical Services (Vol. 1), edited by S. C. Rexford-Welch. H.M. Stationery Office. Price 70s.

POLAND'S AIRCRAFT INDUSTRY

INTERVIEWED by Warsaw Radio, Mr. Nawrocki, described as "head of the Polish aircraft industry," has stated that unprecedented progress has been made in his industry since 1950. In addition to the production of the Kukuruznik Soviet trainer (*sic*) and the Polish-designed Junak two-seater trainer, an experimental helicopter has been built and "a completely new, modern helicopter" is under construction. "Combat jet aircraft" are also being turned out; new cadres of designers and engineers are producing them from Polish raw materials. The "decisive" help of Soviet aircraft designers is acknowledged.

P.P.I. TUBE SIMULATOR

EXTENSIVE field trials are now under way, in Territorial Army units, of a new Standard Telephones radar P.P.I. simulator. A continuous programme of traces moving at a variety of speeds with suitable ground echoes and "clutter" can be set up for instructional purposes, and controlled during operation. The time-base is formed by a rotating beam of ultra-violet light activating the fluorescent screen. Target and other information is superimposed by the interposition between the light-source and the tube face of a substance giving a more pronounced fluorescence. In one version this consists of globules of the substance set on nylon threads and moved by a system of pulleys and motors. As in the operational equipment, a cursor for reading bearings, and range-markers, are included. The P.P.I. simulator is produced by Standard Telephones and Cables, Ltd., of London, W.C.2.

BENDIX IN CANADA

THE well known American aircraft equipment company, Bendix Aviation Corporation, is forming a manufacturing unit in Canada. It will be part of Bendix Eclipse Canada, Ltd., a wholly owned subsidiary which produces automobile components. Plans for the new division include the manufacture and sale of all Bendix products designed for the Canadian market, and present licence arrangements with Canadian firms, including Aviation Electric, Ltd., and Northern Electric Co., Ltd., will continue.

Mr. J. F. Taylor, lately supply manager in charge of procurement and sub-contracting at Avro Aircraft, has joined Bendix as general manager of the new division.

This pleasing "Flight" study of the Comet 2 suggests its re-emergence into the commercial world. Performance of this Avon-powered 44-seater will not be materially affected by the structural modifications.

CIVIL AVIATION

THE NEW COMET 2

SINCE the conclusion of the Court of Inquiry into the Comet 1 accidents off Elba and Naples last year it has not been possible to discuss the prospects of subsequent types of Comet with any degree of certainty. In the first place, it was essential to await publication of the findings of the Court (whose report was still unpublished at the time of writing). Secondly, the manufacturers required time to study the lessons of the accident investigations before deciding the pattern of their future development and sales programme.

Some of the uncertainty was cleared up last week when the de Havilland Aircraft Co. issued a statement outlining the effect of modifications made to the Comet 2 in the light of investigations. The statement made it plain that there will be a sustained effort to sell and produce this mark of Comet for service on the trunk-line air routes of the world, and that, economically, the improved version will be no less attractive than in its 1954 form.

The modifications involve a 1,150 lb increase in structure-weight, but this is partially offset by a 550 lb saving in weight of airframe details in production Comet 2s as compared with the prototype. Furthermore, recent development of the Avon 502 has resulted in a 300 lb increase in the original take-off thrust rating of 7,050 lb, coupled with a small reduction in fuel consumption. As a result, the performance characteristics on which the Comet 2 was offered a year ago (themselves far better than the 1952 figures on which the first sales contracts were based) are little changed.

The most important modification will be the complete rebuilding of the pressure fuselage, incorporating a heavier skin and round, instead of square, windows. This action was forecast in a statement issued at the conclusion of the Comet Inquiry. It was also forecast at that time that the wing structure would be modified to reduce the stress level of parts subject to fatigue, probably by increasing the thickness of areas of skinning and by reinforcing the area aft of the wheel well. Other modifications would result in improved fuel venting and would also prevent the possibility of accidental damage during refuelling. A reduced control break-out force would be incorporated, and tailpipe angle would be altered to reduce jet buffet on the fuselage.

Where take-off weight was previously limited by runway length, the extra 1,200 lb thrust of the four Avons will permit a weight increase of some 2,700 lb, and the lower consumption more than offsets the effect on range of the small drag increase caused by external changes, including the fitting of an external H.F. aerial. Where payload was limited by runway length, an increase of 1,450 lb will be possible, but where payload was limited by fuel requirements there will be a reduction of 140 lb. Where payload was limited only by all-up weight, the reduction will be 440 lb.

The Comet 2 will be able to carry its capacity payload of 13,000 lb on such typical trunk routes as:—Caracas-New York (2,116 miles); Entebbe-Cairo (2,080); Perth-Djakarta (1,876); Karachi-Beirut (1,992) and Entebbe-Johannesburg (1,846). In each case the aircraft is assumed to fly against the maximum head-wind encountered on 85 per cent of occasions.

Not only have the Comet 2 modifications been decided upon but the engineering work required to incorporate them is actually in progress; and the metal required for the new fuselage skins has been obtained. No official announcement has been made on the future of those Comet 2s which have already been completed at Hatfield, but it is thought that with suitable reinforcement of cut-out areas in the pressure hull, they might be used for passenger work by Transport Command. A restriction on airframe life might be necessary, though this would not appear a serious problem since military transport utilization is normally much less than that of airliners. It is also likely that existing Comet 1s will be used as R.A.F. tankers, unpressurized or with a low differential.

WEST AFRICAN ACCIDENT

ONE of the five Bristol 170s of West African Airways Corporation crashed 38 miles from its destination, Calabar, Eastern Nigeria, on February 5th. There were no survivors among the nine passengers and four crew-members (Capt. D. W. Cox, 1st/Off. G. Atkinson, R/Off. D. M. Stott and Flight Clerk D. Jumbo). No indication of the circumstances of the accident were available at the time of going to press.

B.A.L.P.A.'S NEW CHAIRMAN

THE British Airline Pilots' Association announce the election of Capt. A. Spooner, D.S.O., D.F.C., as chairman in succession to Capt. J. Woodman. Aged 38, Capt. Spooner is a senior captain of Stratocruisers on B.O.A.C.'s North Atlantic route. Capt. H. M. Bailey, D.F.C., of B.E.A., has been elected vice-chairman of B.A.L.P.A.

U.K.-PHILIPPINES BILATERAL AGREEMENT

SIGNING of a new civil air services agreement between the United Kingdom and the Republic of the Philippines—at Manila on January 31st—is announced by the M.T.C.A. The agreement provides for the mutual grant of facilities for the operation of scheduled air services and takes effect from the date of

At the conclusion of her flight to Trinidad, H.R.H. Princess Margaret offered her thanks to Capt. P. C. Fair and the crew of his B.O.A.C. Stratocruiser "Canopus." For inter-island travel in the Caribbean, Princess Margaret is using a D.H. Heron flown by the chief pilot of British West Indian Airways.

An assembly line of eleven Viscount fuselages, including Nos. 4 to 10 for T.C.A., fills this erecting shop at Hurn. The shop is one of two recently extended to permit simultaneous work on a total of 24 aircraft.

VISCOUNT PRODUCTION EXPANDED

GOOD progress is reported by Vickers-Armstrongs, Ltd., in increasing the productive capacity of their main Viscount factory at Hurn. The purpose of the expansion programme, which was first announced last August, is to make possible the completion of 55 aircraft in 1955—more than double last year's output.

During 1956, which will see the introduction to the line of the first 800-series, it is intended to build 80 Viscounts. A "considerable further expansion" could take place in 1957, but the exact output would, of course, depend on the number of Viscounts ordered by then. Viscount orders to date total 178 aircraft, of which 46 have been delivered.

There are two main erecting shops at Hurn, both of which were originally 342ft in length; each was capable of holding five fuselages—three with wings fitted and two without. Both these shops have now been extended to a length of 796ft, and side annexes housing electrical shops have been added. Each shop can now accommodate 12 fuselages, six with wings and six with inner planes.

Erecting shop No. 106 (illustrated above) has been in full operation for some time, and the extension to shop No. 107 (below) will be in use by the end of this month.

Other parts of the Hurn factory have also been extended to keep pace with the demands of the new erecting shops. The fuselage shop has been doubled in size and the number of fuselage assembly jigs is being increased from three to eight; in addition, the number of fuselage sub-assembly jigs has been more than doubled.

In taking over the former R.A.F. station headquarters site just outside the airport, Vickers have gained 49,000 sq ft extra floor space for metal treatment and for fitters' shops. A second flight shed has been provided, and new drawing-office accommodation will treble the space available for such work as special customer requirements. Steps have been taken to increase the supply of sub-contracted components (which include the wings, tail unit, ailerons, flaps and part of the undercarriage), and the labour force at Hurn has been practically doubled.

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signature. It replaces an earlier agreement with the Philippine Government signed in January 1948.

The Ministry recall that on August 11th, 1953, the United Kingdom Government gave notice of termination of this earlier agreement with a view to negotiating a new one at an early date. B.O.A.C. will now be able to operate through Manila on a route from London to Tokyo with no restriction on the exercise of traffic rights there. In addition, the agreement provides for regional services by British operators from Hong Kong and Singapore and for services by Philippine operators to United Kingdom territories in the Far East, and to London.

B.O.A.C. do not at present operate through Manila. The airport was used by Tokyo-bound Comets as a refuelling stop, but under the old agreement they were not allowed to pick up or set down traffic.

HELICOPTERS FOR CHARTER

A NEWCOMER to the British helicopter scene is Rotorfilms, Ltd., who will shortly operate the first rotorplane to be continuously available for Press and publicity purposes in the United Kingdom. The aircraft, which is expected to be operating by April, will be a new float-equipped Bell 47G, assembled under licence by the Italian Agusta concern. Rotorfilms have been formed by one of Britain's leading helicopter pilots, Capt. J. Crewdson, who will himself fly the Bell.

Capt. Crewdson, who has more than 1,000 rotating-wing hours to his credit, is a former member of the B.E.A. Helicopter Unit and was until recently chief pilot of Autair, Ltd. Formed last year, Autair are pioneers in the operation of helicopters solely for charter work. The company's fleet consists of three Sikorsky S-51s formerly operated by the B.E.A. Helicopter Unit. Contrary to one report, there is no connection between Rotorfilms and Autair other than—to quote the latter—"a friendly association."

Hitherto much of the flying time logged by Autair has been for advertising and publicity purposes, together with a number of freight and survey flights. Work during the coming year will be more varied: among the most interesting tasks ahead of Autair's S-51s will be "hovermissions"—airborne test transmissions—to determine the best sites for certain Continental television stations. The use of a helicopter, hovering at the proposed height and location, obviates the time and expense of setting-up jury masts.

Interior view of the second Hurn erecting shop, which will be ready for use at the end of this month. The extension is 454ft long, bringing the total length of the shop to 796ft.

IRON-CURTAIN AIRLINE NEWS

MOSCOW reports say that regular air traffic was opened on February 2nd between the Soviet capital and Tirana, Albania. The service operates weekly *via* Kiev, Budapest and Belgrade, and the distance of about 1,525 miles, with landings, is covered in 11 hr 35 min.

Another new Aeroflot service is between Moscow and Yuzhno-Sakhalinsk, *via* Kazan, Sverdlovsk, Omsk, Novosibirsk, Krasnoyarsk, Irkutsk, Chita and Khabarovsk; the service takes 25 hr.

Following negotiations in Moscow between Soviet and

Rumanian Government delegations on January 25th, an agreement was signed on the opening of a regular service between the Soviet Union and Rumania. Direct air communication is thus established on the Moscow - Bucharest route. Flying rights on this route are granted to both Soviet and Rumanian civil aircraft on an equal basis. Soviet flying personnel will supervise the training of Rumanian crews.

From Sofia, a report on recent developments in Bulgarian civil aviation states that three times the number of passengers and ten times the amount of cargo carried in 1950 were transported in 1954. A new route—Sofia - Stara Zagora - Burgas - Stalin—was opened during the year. The amount of agricultural flying done by civil aircraft increased even more; typically, no statistics are given, but the amount of work performed is said to be "38 times as much as in 1950." Bulgarian passenger services will offer 32 per cent more capacity this year than in 1954, the report added.

BREVITIES

FROM February 16th all Qantas services on the London-Sydney route will be operated by Super Constellations. One of the three return flights weekly will be a "Connoisseur" service for 39 first-class passengers only. From March 1st the airline will also be operating three weekly Super Constellation services on the "Southern Cross" Pacific route.

* * *

"Flight 1,000" is the name given by Pan American to a "paper jet operation" designed to provide information for future trans-atlantic services with jet airliners. The exercise, which is similar to those conducted by B.O.A.C. and K.L.M., involves three weekly return "flights" between New York and London.

* * *

Impressive numbers of airline and executive transport aircraft are listed in the latest market report issued by William C. Wold Associates, the New York clearing house. The list includes 47 Beechcraft D-18Ss, 25 Lodestars, 11 Aero Commanders, eight D.H. Doves, four Douglas A-20s, ten North American B-25s and 28 DC-3s.

* * *

Under the auspices of I.A.T.A., an airline public relations conference is to be held at The Hague from February 22nd-25th inclusive. Mr. R. J. Vogels, public relations manager of K.L.M., is in charge of arrangements for the meeting, which will be held at the Kurhaus Hotel; secretary of the conference will be I.A.T.A.'s public relations officer, Mr. S. R. Cohen.

* * *

L.A.N., the national airline of Chile, took delivery on January 27th of the first of three new DC-6Bs. To be introduced to service in March, the aircraft will link Santiago with Buenos Aires, Montevideo, Lima and Magallanes; the airline is also considering the possibility of extending its Lima route to Panama, Mexico City and California.

* * *

Following the introduction of their scheduled all-cargo service between London and Frankfurt on January 12th, Airwork have been granted full voting rights as an I.A.T.A. member. This is stated to be the first occasion in I.A.T.A.'s history on which an airline has qualified for full voting rights on a freight service only. (Airwork's scheduled passenger services, being operated within the Commonwealth, are outside I.A.T.A.'s sphere of direct influence.)

* * *

Mr. P. K. Reynolds, European sales manager of C.P.A., announced last week that the company's trans-Arctic service between Vancouver and Amsterdam will be inaugurated in June on a weekly basis. Eastbound flights will leave Vancouver on Thursdays, arriving at Schiphol 18 hr 30 min later after a refuelling stop at Churchill, Manitoba. Westbound flights, leaving Amsterdam on Friday evenings, will refuel at Sondre Stromfjord.

* * *

The Minister of Transport and Civil Aviation has appointed Sir John Gibson Graham, M.C., as a member of the Air Transport Advisory Council. The appointment will run for the remainder of the Council's term of office—until July 22nd, 1956. Sir John is a director of a number of shipping companies, an underwriting member of Lloyds and chairman of the Baltic Mercantile and Shipping Exchange.

NEW ITALIAN LIGHTWEIGHTS

AN Italian company called Meteor has begun production of a light aircraft in two models, the FL 53 and FL 54, respectively a two- and a three-seater. The factory is at Monfalcone airfield, near Trieste, and the company states that it has taken over the aeronautical work of the Cantieri Riuniti dell'Adriatico, which was before and during the war responsible for the Cant-Zappata aircraft.

The main differences between the two versions of the new light aircraft are in engine power and seating capacity—two seats and 60 h.p., three seats and 90 h.p. Both are intended as successors to the pre-war FL 3, still one of the most successful Italian club aircraft.

Production is at present at the rate of two per month, and the price of the airframe is equivalent to about £1,250, the Italian customer generally being able to supply his own engine. Most frequent choices appear to be the 60 h.p. CNA D4 or the 90 h.p. Continental with metal airscrew.

The two-seater is intended primarily as a pilot trainer, while the three-seater can be used for instruction, aerial work, *turismo*, or glider towing, the aerial work consisting of such tasks as leaflet dropping (popular in Italy) or banner towing. The rate of climb of the FL 54 with pilot only is such that it can tow a fully loaded Canguro glider (a.u.w. 1,090 lb) at 540ft/min.

Electrical systems are not normally fitted in either version, but generator, battery and electric starter are optional extras. In addition, the three-seater can carry a self-contained removable V.H.F. set instead of a third person, and full night flying equipment can also be added.

Both versions are aerobatic at an all-up weight of 1,150 lb, the maximum a.u.w. of the FL 54 being 1,380 lb. A 13-gallon ventral tank can also be attached to bolts under the centre section, fuel being fed to the main tank by hand-pump along a pipe which enters the fuselage by the leaflet chute.

As the photographs of the FL 53 show, the aircraft has the slightly ungainly appearance typical of Italian machines of this class, but it has been designed for strength and durability in club operations. The fuselage, of mixed metal, wood and fabric construction, is quickly detachable from the wings and undercarriage, which come away as a single unit. The canopy has a crash-pylon structure to give protection in the event of overturning, though such a mishap is unlikely, since the undercarriage is extremely strong and stable. The wheels have ball bearings and hydraulic brakes, and the tailwheel can be steered from the rudder pedals. Flaps are not considered necessary, but can be fitted as an extra, and the ailerons are slotted and have differential transmission.

Flying characteristics are viceless, a stall resulting in a slight initial wing drop which immediately corrects itself, and the aircraft recovers of its own accord with the nose only slightly below the horizon. The standard instrumentation includes primary blind-flying instruments. Both the FL 53 and the FL 54 should prove an attractive proposition for Italian flying clubs.

The dimensions of both the FL 53 and FL 54 are 33ft 8in and length 21ft 6in. The wing loading varies according to the aircraft's layout, but at its maximum it is only just over 9 lb/sq ft. Performance similarly varies with the type of engine fitted. Maximum speeds are between 100 m.p.h. and 115 m.p.h. and cruising speeds about 15 m.p.h. lower. Stalling speed is quoted by the makers as 37 m.p.h.

Bell's Jet Vertical Riser

HAILED as "the U.S. aviation industry's answer to the British flying bedstead" the VTOL (vertical take-off and landing) prototype by the Niagara division of the Bell Aircraft Corporation has now been unveiled. Although it embodies no obvious technological advances it has a configuration which makes it, at the present time, unique.

The basic airframe is a conventional parasol monoplane, with a light stressed-skin structure. As far as can be ascertained, it has not been specially designed for the job, but has been built from existing parts. The undercarriage is a double-skid similar to that used on the Bell 47 helicopter. The skid struts are joined by a pair of parallel transverse tubes, the deflection of which seems to provide the only concession to landing-shock absorption. The transverse tubes are in turn attached to a pair of cradles in which the fuselage rests. These cradles also carry a jet-deflecting plate to protect the under-surface of the fuselage.

The thrust for both vertical lift and forward propulsion is provided by a pair of Fairchild J44 turbojets. The precise method of mounting these units has not been revealed, but it is fair to assume that the monocoque structure of each J44 is attached to a mounting pad on either end of a horizontal tube passing through the fuselage at the c.g. position and rotating in bearings. The turbojets are arranged to rotate as a pair about this horizontal axis so that their thrust-lines can be directed at any angle between vertically downward and horizontally to the rear. Flexible fuel-lines can be seen leading to each engine and other pipes and controls may be arranged to pass through the mounting pivots.

The airframe is highly conservative; in fact, it looks as if sufficient wing has been provided to enable "dead-stick" landings to be made at a low airspeed, although no wheels are fitted at present.

The VTOL is a small aircraft, much smaller than the average light trainer or club machine. The pilot is seated in an open cockpit, and his head is in quite close proximity to the mesh-guarded intakes of the three gas turbines. The cockpit is extremely spartan, and what appears to be the main engine control box is mounted on the outside of the cockpit coaming.

Control at low airspeeds is provided by compressed-air jets at the tail and wing tips, fed from a Continental-Turboméca Palouste gas-turbine/compressor unit mounted on the centre line above the fuselage. This plant has an oversize compressor which provides a maximum delivery of 1.9 lb of compressed air per second, which is tapped from the engine casing and led off through pipes. The combustion gases are expelled above the rear fuselage, through an outlet facing to port.

Conventional ailerons, rudder and elevators are fitted for control in normal forward flight. The control linkage to the tail surfaces, and the tips of the ailerons themselves, are joined *via* push-pull rods to the valves controlling the pitch, yaw and roll jets fed by the Palouste.

The Bell test pilot, David W. Howe, gives scale to the nose of the curious machine he is now testing. The J44 turbojets are shown in the horizontal position. The prototype cost the company about £178,000.

BELL VTOL EXPERIMENTAL PROTOTYPE

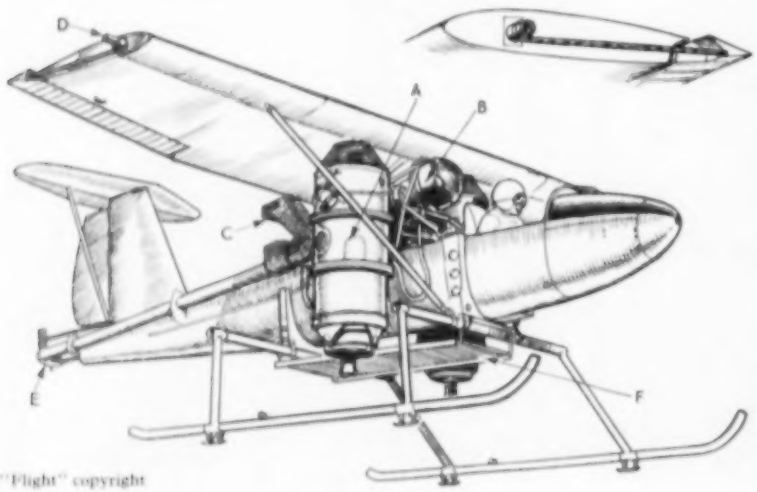
Two Fairchild J44 turbojets and one Continental-Turboméca Palouste compressor. Span, 26ft; length, 21ft; wing area, approximately 130 sq ft; all-up weight, about 2,000 lb; wing loading, about 15 lb/sq ft; maximum forward speed, probably restricted in present form to about 150 m.p.h.

Fairchild J44: monocoque turbojet with diagonal-flow compressor, annular combustion chamber and single-stage turbine. Diameter, 22in; length, 76in; dry weight of unequipped engine, 310 lb; maximum thrust, 1,000 lb at 15,780 r.p.m. with specific consumption of 1.65 lb/hr/lb.

The VTOL is designed to take off with the J44s pointing downwards and with stability provided solely by the compressed-air control jets. When clear of the ground it is intended that the J44s should be gradually tilted to provide forward thrust, the airspeed, turbojet-tilt and wing-lift being co-related to maintain the desired flight-path. At a sufficient forward speed for the conventional control surfaces to take effect the Palouste would probably be cut out by a circuit initiated by a signal from a ram-pressure head. In full flight the machine would behave as a conventional twin-jet fixed-wing aircraft. For landing the speed would be reduced by returning the J44s to a vertical plane and then lifting the nose of the aircraft. A vertical descent could then be made, under the control of the compressed-air jets.

Altogether, the Bell VTOL seems to be a useful and capable experimental test vehicle, although it is questionable how much of the information it provides will be applicable to future designs. The control system is claimed by Bell engineers to be "the first practical application of reaction controls" and, although this claim is open to question, the control-system research made possible by the VTOL will probably be very rewarding.

At the time of writing the machine had already completed more than 20 flights at Niagara Falls municipal airport, the first flight having taken place last November. The test flying has so far all been done by one of the company's test pilots, Mr. David W. Howe. The J44s have not yet been rotated in flight more than a few degrees from the vertical position, but full forward flight with the turbojets horizontal is scheduled in a few weeks' time.



In direct contrast to Rolls-Royce conclusions, Bell's prototype uses the same engines for both lift and forward propulsion. Key to drawing:

A, starboard Fairchild J44 turbojet (shown in vertical position); B, Continental - Turboméca Palouste; C, Palouste exhaust stack-pipe; D, Roll-jet at wing-tip (shown in the inset sketch); E, Pitch and yaw jets governed by tail controls; F, deflector plate to protect fuselage from jet buffet during hovering near the ground.

"Flight" copyright

He was tough — but he couldn't take it!

Building up armour and adding another spike to his offensive equipment wasn't enough to keep the triceratops from becoming obsolete. His biggest enemy was the thermometer — as soon as it began to fall below his designed operational temperature he became obsolescent. The same thing can happen to an aeroplane engine before it leaves the test bench unless it has been designed with a full knowledge of the performance and availability of fuel and lubricant requirements. In fact the whole problem of designing future aircraft and power units is bound up with this constantly changing picture. If you want to keep in touch with developments in this field — or if you have any problem associated in any way with aircraft fuels and lubricants — why not ask ESSO about it ?

It pays to consult

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Two Exchange Postings

AN officer of the Royal Australian Air Force, A. Cdre. J. D. McLachlan, C.B.E., D.F.C., has been appointed Director of Flying Training at the Air Ministry. This is an exchange posting, and A. Cdre. A. G. Adnams, R.A.F., is on his way to Australia to become Commandant of the School of Land/Air Warfare and Commanding Officer of the R.A.A.F. station at Williamtown.

A. Cdre. McLachlan commanded the

A. Cdre. J. D. McLachlan, C.B.E., D.F.C., R.A.A.F.

first Australian squadron—No. 3—to go overseas in the last war and was also the first R.A.A.F. fighter pilot to be awarded the D.F.C. He took last year's course at the Imperial Defence College.

A. Cdre. Adnams was, until recently, a member of the Defence Research Policy Committee and served also on the Joint Planning Staff.

R.C.A.F. Neptune Courses

EXPECTING to re-equip its maritime squadrons with Neptunes early this year, the Royal Canadian Air Force has made arrangements for aircrews and groundcrews to attend courses at the Lockheed factory at Burbank, California.

"Ark Royal" to Commission

THE first British aircraft carrier to have all the post-war developments in flight-deck equipment and technique, H.M.S. *Ark Royal* is to be commissioned on February 21st under command of Capt. D. R. F. Cambell, D.S.C., R.N., who, with Mr. L. Boddington of the R.A.E. at Farnborough, conceived the idea of an angled deck.

H.M.S. "Ark Royal," which is to be commissioned for the first time on February 22nd. The new carrier is seen here on the measured mile off the Isle of Arran during speed trials.

In maritime circles it is considered that the new carrier will be the most formidable unit of the Royal Navy. In addition to the angled deck she will have steam catapults, a new type of arrester gear with only six wires, an extra lift on the port deck-edge, mirror deck-landing aid, improved hangar ventilation and an aircrew refreshment centre. Crash barriers will only be used in the event of an aircraft losing its hook. The deck innovations should enable the most modern types of aircraft to be operated both safely and quickly. It is expected that a maximum differential of 110 knots between the airspeed over the flight deck and the landing and take-off speed of the aircraft can be accepted.

Of 808ft 3in in length (720ft between perpendiculars), *Ark Royal* has an extreme breadth on the waterline of 112ft 9ins. She displaces 36,800 tons. Her peacetime complement will be 110 officers and 1,522 ratings, and when frontline aircraft are embarked there will be an addition of approximately 100 officers and between 450 and 500 ratings. Armament consists of sixteen 4·5 guns and 45 smaller weapons. In spite of the fact that her sister ship, H.M.S. *Eagle*, was completed first, it is H.M.S. *Ark Royal* that will give her name to the class.

Much attention has been devoted to photographic needs. Photography is playing an increasingly important part in naval warfare, both operationally and for training purposes. It is used for the recording of all deck landings, of radar traces and instruments, and in association with, or even as an integral part of, modern weapons. *Ark Royal's* photographic section is therefore capable of dealing with a wide variety of demands. A universal processing machine, occupying only 12 × 2½ft of deck space, can develop and dry all widths of film in use in the Service from 16 mm to 9½in wide. The processing can be carried out at a speed as fast as 1,200ft/hr. Vibration-free enlargers will operate with the ship travelling at full speed and in any kind of sea.

Duncan Trophy

AWARDED annually to the day-fighter squadron of 2nd T.A.F. achieving the best results in air-to-air gunnery, the Duncan Trophy has been awarded for 1954 to No. 266 (Rhodesia) Squadron, based at Wunstorf, Germany. The unit is commanded by S/L. W. J. T. Henderson. No. 118 Squadron was second and No. 11 Squadron third. All three squadrons are equipped with D.H. Venoms.

London U.A.S. Dinner

THE annual dinner of the University of London Air Squadron on Friday last was brightened considerably by the presence, for the first time, of the squadron's lady members. After a reception at the squadron's South Kensington headquarters, the dinner itself was held in Imperial College, where the Commanding Officer, W/C. I. J. Spencer, D.F.C., proposed the health of the guests.

Among the guests present were the Under-Secretary of State for Air, the Vice-chancellor and the Principal of London University, the Director of the W.R.A.F., and heads of the women's colleges of the University. Also mentioned by W/C. Spencer were his three predecessors—G/C. A. V. Rogers; W/C. A. W. Heward; and A.V-M. F. H. M. Maynard, who

The Meteor 8s of No. 77 Squadron—which recently returned to Australia from Korea after ten years abroad—lined up at Laverton during a tour of Australian capital cities.

In the news: (Left) A.V-M. N. H. D'Aeth presents the Hack Trophy to W/C. L. J. M. Bunce, C.O. of the Glasgow University Air Squadron. In the background are Sir Hector Hetherington, Principal, and Prof. J. D. Mackie. (Centre) W/C. D. Connor, who recently broke the Cresta Run record with a time of 44.6 seconds. (Right) the R.A.F. team who won the Inter Services Cresta Championship: F/L. L. L. Cumming, F/L. C. N. C. Mitchell and F/Sgt. W. A. Larowski.

SERVICE AVIATION . . .

formed the squadron in 1935. The reply on behalf of the guests was voiced by Dr. D. W. Logan, M.A., D.Phil., Principal of the University of London.

Air Chief Marshal Sir Francis J. Fogarty, K.C.B., K.B.E., D.F.C., A.F.C., Air Member for Personnel, next proposed the health of the squadron. He traced the impressive record of the University Air Squadrons in general, and of London's squadron in particular. There was room for more U.A.S. personnel in the R.A.F., he remarked: the sight of the members there that night made him feel very greedy—and he certainly included the fighter controllers.

The response was made by F/O. E. J. Posey, of the London School of Economics, who wondered how the squadron's fighter controllers had been chosen—good personal appearance, ability to make rapid decisions, or ability to keep their heads in all emergencies? The squadron was asking for higher-performance aircraft—not supersonic types; indeed, these could not be flown from Booker. But then a bigger airfield, possibly? . . .

More co-operation with regular R.A.F. squadrons would be a good thing, F/O. Posey submitted; an extra fortnight's flying during the long vacation was quite feasible. The speaker concluded by suggesting that the squadron's maxim "Learn by Degrees" should now be applied to the consumption of its famed vintage cider at Headquarters. Whereupon those present ventured back across Exhibition Road to do just that.

R.A.F. Appointments

THE Air Ministry has announced the following appointments: A.V-M. C. E. Chilton, C.B., C.B.E., to be S.A.S.O., Coastal Command; A.V-M. P. D. Cracroft, C.B., A.F.C., to be A.O.C. No. 18 Group, Coastal Command and Senior Air Force Officer, Scotland; A.V-M. A. Earle, C.B.E., to be Assistant C.A.S. (Policy); and A. Cdre. K. J. McIntyre to be Director of Policy (Air Staff).

A.V-M. Chilton and A.V-M. Cracroft are both air/maritime specialists; the former is at present Assistant C.A.S. (Policy) and the latter is S.A.S.O. at Coastal Command. A.V-M. Earle is now Director of Policy (Air Staff) and A. Cdre. McIntyre is a member of the Operations and Plans staff at SHAPE.

Two further appointments recently announced are those of A. Cdre. H. J. Butler, C.B.E., who becomes S.A.S.O. No. 41 (Maintenance) Group, and G/C. E. M. Donaldson, C.B.E., D.S.O., A.F.C., who takes over the newly-established Directorship of Operational Training. He will assume the acting rank of air commodore.

A. Cdre. Butler has been Director of Equipment (B) since the summer of 1951 and before that served in the Far East.

A. Cdre. Donaldson will be remembered as the first pilot to exceed 1,000 km/hr on one run when, on September 7th, 1946, flying a Meteor, he set up a world's speed record of 616 m.p.h. (991 km/hr)

2nd T.A.F. Markings

FIGHTER squadrons of 2nd T.A.F. in Germany are now allowed distinctive squadron markings. Mostly symbolizing events in the units' histories, there are some ingenious examples. The scarlet crusaders' cross of No. 145 Squadron recalls the unit's operations in 1918 in support of Allenby's final drive against the Turks, and No. 67 has adopted a *motif* of red, yellow and blue panels offset at an angle to indicate that it was the first R.A.F. squadron to have swept-wing aircraft (Sabres); No. 2 Squadron has revived the triangle painted on its first-war aircraft, and No. 4 with a golden lightning flash, recalls that it was the first squadron to make use of air-to-ground wireless (1914).

British Carriers with Sixth Fleet

TWO British aircraft carriers, H.M.S. *Centaur* and H.M.S. *Albion*, recently joined the U.S. Sixth Fleet in the Western Mediterranean for six days of combined exercises which included flight operations, gunnery and communications practice, and replenishment at sea.

The British carriers, with Rear-Admiral A. R. Pedder, R.N., flying his flag in *Centaur*, joined a part of the Sixth Fleet force early on Wednesday. Both of these carriers are fitted with the angled-deck arrangement, and H.M.S. *Albion* also has the mirror sight deck-landing aid, enabling aircraft to land without the help of a landing signal officer.

Rear-Admiral Pedder is Flag Officer British Aircraft Carriers, and his force is at present operating within the British Mediterranean Command of Admiral Sir Guy Grantham, K.C.B., C.B.E., D.S.O., D.S.C.

Vice-Admiral T. S. Combs, U.S.N., Commander U.S. Sixth Fleet, welcomed Rear-Admiral Pedder personally at luncheon on board his Tactical Command Flagship, U.S.S. *Northampton*. The British Admiral transferred by helicopter from H.M.S. *Centaur* for the purpose of the visit.

The U.S. Sixth Fleet includes the aircraft carriers *Randolph*, flagship of Rear-Admiral Frank Akers, U.S.N., Commander Carrier Division II, and the *Lake Champlain*. The combined force of four carriers conducted flying operations for two days under the overall command of Vice-Admiral Combs.

Reunions

THE reunion of No. 84 Squadron will take place on Saturday, March 5th, at the "Prince of Wales," Drury Lane, London, W.C.2. Tickets (7s 6d) from O. Greenwood, 4 Kensington Court, London, W.8.

No. 780 Squadron R.N., is holding its ninth annual reunion dinner on Friday, March 25th, at Simpsons-in-the-Strand, London. Particulars from Cdr. J. Goodyear, R.N.V.R., 2 Park Way, Rickmansworth, Hertfordshire.

The new light fleet carrier H.M.A.S. "Melbourne" enters the dry dock at Belfast following steaming trials. Later this year she will be handed over to the Royal Australian Navy. "Melbourne" (14,000 tons) was laid down in 1943, but her completion, originally due in 1950, has been delayed in order to incorporate modern flight - deck arrangements.

Hard water: The two photographs referred to in the letter "A Swordfish Skates In."

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

A Swordfish Skates In

IN his book *Mach One,* Mike Lithgow recounts how amazed he was one day when a Swordfish floatplane landed on the deck of the wartime H.M.S. *Ark Royal,* to deliver the ship's captain, who had been delayed at Gibraltar when the carrier left to take part in the Dakar operation.

He was, apparently, even more surprised when, instead of needing repairs after the incident, the "Stringbag" was simply picked up by a crane and deposited on the sea, with its engine still running—whereupon it promptly took off and headed for home.

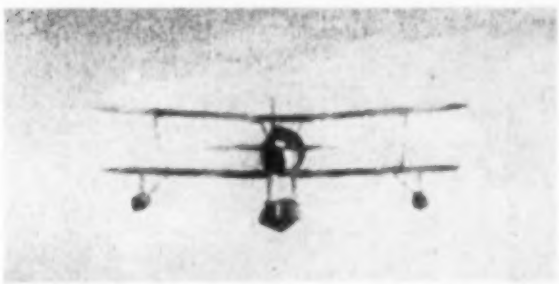
In fact, it was by no means the first time that a Naval floatplane had "landed on." As early as July 1927 the Fleet Air Arm made a series of trials, in which both Fairey IIIF and Flycatcher seaplanes made landings on the deck of H.M.S. *Furious.* These experiments were described and illustrated in an article by Mr. B. J. Hurren in *Flight* of October 14th, 1948.

I have recently come across two photographs [reproduced above—Ed.] of a Swordfish landing with its boots on. Can any reader supply details?

Surbiton, Surrey. J. W. R. TAYLOR.

TV Recognition Contest

CONGRATULATIONS to Mr. Wilkes (Correspondence, January 21st) on a snappy piece of spotting. The Japanese floatplane catapulted off in Episode 7 of TV's *War in the Air,* was, indeed, a Dave and not a Pete as I reported, as can



Dave, not Pete: an unretouched "frame" from the B.B.C. air-war film.

be seen in the enclosed still "blown up" from the film [and reproduced here—Ed.].

The "tantalizingly brief glimpse" shown, was I fear, too short for me to notice the high-set tailplane and multiple float-attachment struts which differentiate this machine from the Pete.

London, S.E.19. M. F. A.

High-lift Generation

THE recent articles on high-lift generation by Mr. A. R. Weyl bring to my mind a series of flight trials and wind tunnel experiments undertaken by Taylorcraft Aeroplanes (England), Ltd. (as it was then), during the spring of 1940, in connection with a form of spoiler.

The experiments were initiated by the late Mr. A. L. Wykes and suggested by an article, published in *Popular Flying, circa* 1938, concerning the effects of spoilers fitted to sailplanes as control surfaces.

A Taylorcraft Model D, one of the first machines fitted with a Cirrus Minor engine, was modified to take the spoilers. They consisted of plates hinged to the front spar (30 per cent chord) forward of the ailerons and actuated by a torque tube and linkage. Angle of plate to chord line in the "up" position was 60 deg.

Flight trials produced the following results, quoted from memory. Stable flight was achieved at 20 m.p.h. (measured by a car speedometer) at about 40ft, with adequate lateral control at an angle of attack of around 30 deg to 40 deg. I flew the aircraft (at a greater height) and could maintain this attitude with the stick back on half throttle. The A.S.I. was on the bottom stop and I could do gentle aileron turns. Landings were also carried out, but the rate of sink was very high and they were anything but gentle.

Wind-tunnel tests were made by Loughborough College and the explanation put forward was that the plates had the effect of locally increasing the camber and thickness and at the same time maintaining effective flow over the aileron.

The recent wintry weather reminds me of the fact that we flew what was probably the first ski-equipped aircraft in this country, in January 1940. The whole project, from idea to flight trials, took three days.

Loughborough, Leics. J. O. KEEPING.

Fatigue Testing

IT was, I believe, stated at the Comet Inquiry that there is no way of determining the state or amount of fatigue.

I suggest, however, that there is a way. Fatigue is caused by the flexing, or loading and unloading of the metal, which eventually weakens the structure and so causes a failure or breakage. The test I suggest is that a portion of the metal forming the skin of the aircraft be arranged to form part of an electrical circuit; when new and unflexed or unfatigued, it will have a certain electrical resistance. Let the metal be flexed, and a different reading should appear, owing to alteration in the molecular construction of the metal having taken place. This could be calibrated until a danger point appeared.

I believe that, on this principle, an apparatus could be made which would enable inspectors to test an aircraft skin at places where fatigue was known or suspected. If the machine was calibrated when new it could then be given a safety limit, not on hours flown but on the metal resistance. Hours flown is an unreliable standard, because the amount of flexing depends on weather conditions which, of course, are not stable.

Purbrook Heath, Hants. E. P. BEER.

[We doubt whether, applied to areas of structure (as opposed to small test-specimens), such a test would show variations of great enough magnitude to provide the required proof.—Ed.]

FORTHCOMING EVENTS

Feb. 11. Helicopter Association: "Development Experiences with the Bristol Type 173," by R. Hafner, F.R.Ae.S.

Feb. 14. Institute of Transport: Brancker Memorial Lecture: "Influence on Civil Aviation of Some Current Researches," by Sir Arnold Hall, F.R.S., M.A., F.R.Ae.S.

Feb. 15. R.Ae.S. Graduates and Students: Discussion: "Is Post-graduate Study Abroad Worthwhile?" (chairman, Sir Arnold Hall).

Feb. 16. Institute of Metals: Informal discussion on "The Treatment of Swarfs, Sawings and Residues in the Non-Ferrous Metal Industries" (at Birmingham University).

Feb. 17. R.Ae.S. Section lecture: "Problems Associated with Stress Concentration," by H. L. Cox, M.A., F.R.Ae.S.

Feb. 18. Institute of Welding: London branches' annual dinner.

Feb. 18. Institute of Navigation: "Automatic Dead Reckoning Instruments," by H. C. Pritchard.

Feb. 18. A.T.A. Association: Reunion dinner.

Feb. 19. British Interplanetary Society (provisional Yorkshire branch): Film show.

Feb. 22. R.Ae.C. Film show.

R.Ae.S. Branch Fixtures (to Feb. 23):—

Feb. 11, *Birmingham,* "The Development of Reheat," by J. L. Edwards; *Glasgow,* "Operation and Servicing of Jet Engines," by J. R. Nutter. *Feb. 14, Halton,* Electronic Equipment. *Feb. 16, Manchester,* "The Scientific Approach to Production Problems," by Prof. J. V. Connolly. *Feb. 17, Yeovil,* "Fatigue," by Dr. P. B. Walker. *Feb. 21, Halton,* Branch night; "Aircraft Operations in the Arctic," by Maj. Webb; *Henlow,* "Aircraft Production," by Prof. J. V. Connolly. *Feb. 22, Belfast,* "Trends of Engine Development," by Dr. S. G. Hooker. *Feb. 23, Preston,* Lecture; *Southampton,* Branch prize papers; *Weybridge,* R. K. Pierson Memorial Lecture, by W. E. W. Petter.

THE INDUSTRY

Blackburn Apprentices Rewarded

SPEAKING at the 24th annual presentation of awards to apprentices of Blackburn and General Aircraft, Ltd., Sir Harry Garner (formerly Chief Scientist, M.o.S.) recalled his first association with the firm over 30 years ago. At that time interest centred on a large aeroplane, the Iris flying boat, which had both civil and military possibilities. Today, he said, an even larger aeroplane had even greater possibilities.

After mentioning that the apprentices at Brough had the opportunity to work on aircraft, piston engines and gas turbines, a combination that was rare in this country, Sir Harry presented the prizes to 87 boys; these awards consisted of books, tools and instruments to the value of £221.

Mr. Eric Turner (managing director) announced the award of Robert Blackburn prizes of £50 each to B. H. Croft and A. F. Schofield, as well as £25 to C. Bryant. The directors' prize —a wrist-watch—for the best all-round craft apprentice went to S. T. Smith. In his speech Mr. Turner spoke of the bright prospects of the company and said that at Brough there were now over 700 more people employed than a year ago.

Sir Harry Garner, at the Blackburn and General Aircraft prize presentation (see col. 1), hands apprentice R. Jennings his share of books—among which, incidentally, is a copy of "Flight Handbook."

For Efficient Lighting-up

ILLUSTRATED below is a new high-energy torch igniter developed by K.L.G. Sparking Plugs, Ltd. (an associated company of Smiths Aircraft Instruments). Originally produced for the de Havilland Ghost, and developed for use with the Dowty spill-burner fuel system, it can be employed in other types of gas turbine. Igniters normally consist of an ignition plug, the spark of which touches off the edge of the fuel spray from the main burner. Sometimes, through a combination of circumstances, the fuel is not ignited sufficiently quickly, and a "wet" start may follow —or, in the air, difficulty in relighting. Without altering the overall dimensions of its present igniter adapter, K.L.G. have, in conjunction with the de Havilland Engine Co., redesigned the unit to include a fuel atomizer alongside the igniter. The centre of the fuel nozzle that provides this auxiliary spray is only 0.5in from the high-energy igniter electrode. During the starting cycle, fuel from the auxiliary spray ignites in a ball of flame which penetrates well down into the main fuel stream.

The new K.L.G. igniter.

A Belfast Appointment

FROM Short Brothers and Harland, Ltd., comes the announcement that Mr. Kenneth Teale, A.M.I.Prod.E., has been appointed as chief efficiency engineer. He has been with the company since 1951 as machine tool design engineer. He joined Shorts from Wadkin, Ltd., of Leicester, where he was their senior designer of tools for the aircraft industry, specializing in high-speed spindling machines. Mr. Teale was responsible for the introduction of special machine tools for Short Bros.' Comet and Canberra contracts. In the autumn of 1953, together with Mr. R. E. Harvey (general manager) and Mr. R. Boorman (chief structural engineer) he made a 12,000-mile trip, throughout the United States, visiting various aircraft and machine-tool factories to study production.

Mr. K. Teale.

IN BRIEF

The Hunting group of companies announces the appointment of Mr. David Bett as group public relations officer, in succession to Prince Yurka Galitzine.

* * *

Jenks Brothers, Ltd., Britool Works, Bushbury, Wolverhampton, manufacturers of small tools, announce the introduction of new series of slim, chrome-alloy, open-jaw wrenches and bi-hexagon ring wrenches; and normal carbon-steel spearhead open-jaw wrenches.

* * *

Lacy-Hulbert and Co., Ltd., of Beddington, Surrey, have gone into production with a new model of their RB2 rotary air pump, designed for continuous operation at vacua up to 25in Hg and pressures up to 10 lb/sq in. The outstanding advantage claimed is that the supply is completely oil-free.

* * *

The Institution of Mechanical Engineers has awarded Whitworth Society Prizes to W. R. Bick and R. Williams, apprentices at Saunders-Roe, Ltd., in recognition of their exceptional achievement in the Ordinary National Certificate Examinations held last summer. Both passed with three distinctions, and average marks of 93 per cent.

* * *

It is announced that Mr. Robert H. Hawley has been appointed to the newly established position of military sales manager to Avro Aircraft, Ltd., Malton, Ontario. He was previously director of sales in the Oakland Aircraft Division of Willys Motors Inc., at Los Angeles. Before that he had been with Chase Aircraft, Lockheed Overseas, Bell Aircraft and Sperry Gyroscope. He had also, at various times in his career, been a Ford test pilot, an airline pilot, and the owner of a charter-flying business.

* * *

When, recently, the Avro Superintendents' and Foremen's Council held their annual dinner, a silver cigarette case was presented to the managing director, Sir Roy Dobson; it was to commemorate his forty years of service, which he completed last year.

* * *

High Duty Alloys, Ltd., announce that Mr. C. J. Williams has been appointed to succeed Mr. J. A. Wellings as manager, casting division. Mr. Wellings relinquishes the appointment on taking up his duties as director and vice-president of Canadian Steel Improvement, Ltd., in Toronto. Mr. Williams joined H.D.A. in 1935 and was trained as a metallurgist. In 1941 he was appointed foundry metallurgist and remained in that position until 1953, when he was made assistant manager of the casting division.

* * *

In *Flight* of December 24th there appeared a photograph of a line-up of 70 B-45Cs of the U.S.A.F. 47th Bombardment Wing at Sculthorpe, Norfolk. Referring to this picture, the firm of Valay Industries, Ltd., state that every one of these aircraft had been polished with "Wadpol" aircraft polish. The use of this medium, and of the associated product "Jove Aerowax," was described in some detail in our issue of August 20th, 1954.

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Interviews in England will be arranged during February, 1955. Please submit details of qualifications and experience to

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Also required are engineers with instrumentation, armament, radio, radar and systems experience to work with flight test operations.

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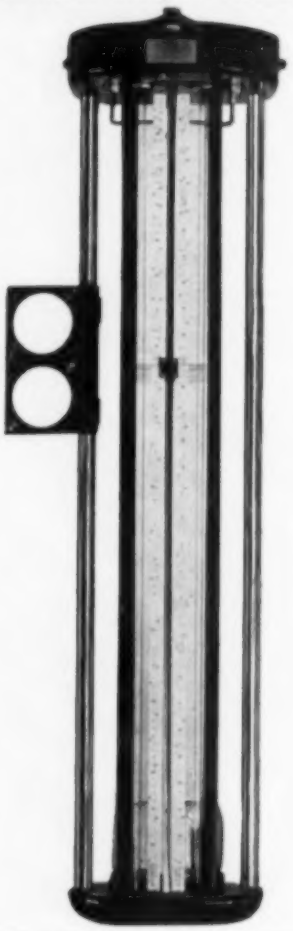

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the under-mentioned applications to operate scheduled air services:—

APPLICATION No. 456. From Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1. For an all freight service initially with Viking, and Bristol 170 aircraft for the carriage of freight between London and Johannesburg with intermediate traffic stops at Marseilles, Rome, Cairo, Khartoum, Nairobi, N'dola and Salisbury, and technical stops at Athens, Wadi Halfa, Juba and Tabora at a frequency of one service weekly, increasing according to demand during the period from July 1st, 1955 to June 30th, 1965.

APPLICATION No. 428 Amended. From Airviews, Ltd., of Ringway Airport, Manchester. For a seasonal U.K. internal service with D.H.89 aircraft for the carriage of passengers and supplementary freight between Manchester (Ringway) and Newquay with an intermediate traffic stop at Bristol (Whitchurch) at a frequency of from one to three services weekly during the season from April to October inclusive each year, for a period of seven years, commencing April 1st, 1955.

FROM Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1.:—

APPLICATION No. 457. For a normal scheduled service with Viking, D.H. Heron, Marathon and/or Dakota aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and Belgrade (Zemun) with intermediate traffic stops at Lille, Munich and Graz (optional) at a frequency of one service weekly increasing according to traffic demand during the period from June 1st, 1955 to May 31st, 1962.

APPLICATION No. 458. For a normal scheduled service with Viking, D.H. Heron, Marathon and/or Dakota aircraft for the carriage of passengers, supplementary freight and mail between Birmingham (Elmdon) and Belgrade (Zemun) with intermediate traffic stops at Lille, Munich and Graz (optional) at a frequency of one service weekly increasing according to traffic demand during the period from June 1st, 1955 to May 31st, 1962.

APPLICATION No. 459. From Air Kruise (Kent), Ltd., of Lympne Airport, Lympne, Kent. For a seasonal inclusive tour service with Dakota aircraft, in conjunction with Transglobe, Ltd. (Birmingham) for the carriage of passengers between Birmingham (Elmdon) and Ostend at a frequency of one service weekly during the season from April to October inclusive each year, for a period of three years, commencing April 1st, 1955.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [3275

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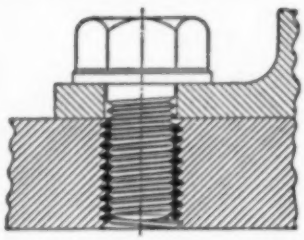

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5. Fuller details and application forms may be obtained from Director (P), Naval Education Service, Admiralty, London, S.W.1. Completed application forms should be returned, if possible, before May 31st, 1955. [3268

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CENTRAL AFRICAN AIRWAYS CORPORATION

Vacancy—

SENIOR INSPECTOR WORKSHOPS

Applications are invited for the above post at Salisbury, Southern Rhodesia.

Duties will consist of Supervision of Workshops Inspection which covers the following: Engine overhaul and repair (P. & W. R.985, R.1830-90D and Hercules 634); Propeller overhaul and repair (De Havilland and Hamintol types); Machine shop work; Metal shop work, including various types of welding, instrument overhaul and repair; Electrical component overhaul and repair, including ignition apparatus; Airframe component overhaul and repair.

Qualifications required are:—

(a) High standard of general education;

(b) Aircraft maintenance engineer's licences to cover the class of work described. Category D for engines exceeding 1,000 b.h.p. with rating to cover construction of components and parts including materials used or equivalent metallurgical experience is essential;

(c) Considerable experience of piston engine overhaul, knowledge of gas and propeller turbine engine overhaul would be an advantage;

(d) A capacity for inspection and administrative work.

The commencing salary will be determined according to the qualifications of the successful applicant and will be in the region of £1,500 per annum including cost-of-living allowance. It will be necessary to serve a probationary period of three months, after which time the applicant, if satisfactory, will be confirmed in appointment.

The Corporation has a Medical Aid Scheme and Pension Fund and membership of these will be compulsory.

Applications in writing, giving details of age, qualifications, previous experience, marital status, number of children, etc., accompanied by copies of testimonials, should be addressed to the

Engineering Manager,
Central African Airways Corporation,
P.O. Box 1979, Salisbury,
Southern Rhodesia,

and should reach the above not later than 28th February, 1955.

CAREERS in the AIRCRAFT INDUSTRY

A large number of recruits to the Aircraft Industry is required immediately.

The Bristol Aeroplane Company Limited, at Filton, has an extensive design and construction programme to implement in both the Military and Civil Aircraft fields. Large Civil Aircraft, Helicopters and Guided Missiles are included in this programme.

Draughtsmen and Technical Engineers with structural and mechanical experience are particularly welcome to apply for employment. The following are required:—

(a) **Intermediate, Senior and Design Draughtsmen** in the various design drawing offices, including Structures, Systems, Electrics, Electronics and Mechanical sections.

(b) **Intermediate and Senior Technical Engineers** in the Structures Analysis, the Aeroelasticity, the Power-control Sections, the Systems Group and the Engineering Development Laboratories where the facilities are modern and extensive.

A Degree or Higher National Certificate in Aeronautics, Mechanical or Structural Engineering is required.

(c) **Intermediate and Senior Technicians** in the Performance, Aerodynamics and the Wind Tunnel sections of the Aerodynamics Departments.

A Degree or Higher National Certificate in Aeronautics or Mechanical Engineering is required.

(d) **Designers, Technical Engineers and Aerodynamicists** in the Helicopter Design Offices.

Here, helicopter experience is desirable.

Good salaries, working conditions and prospects, together with the pension and welfare schemes, make employment with the company an attractive proposition, well worth considering.

Applications, giving details of experience, qualifications and salary required, quoting D.O.25, should be addressed to the **Personnel Manager, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Filton, Bristol.**

TUITION

A.F.R.Ae.S., A.R.B.Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms; over 95 per cent. successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng. write for 144-page handbook free.—B.I.E.T. (Dept. 702), 29 Wright's Lane, London, W.8. [0707

BRITAIN'S AIR UNIVERSITY CAN TRAIN YOU for an airline career. Hundreds of today's airline captains and key maintenance personnel are graduates of this famous establishment. Courses are available for Commercial and Airline Transport Pilots' Licences, Instrument Ratings and Maintenance Engineer's Licences.

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AERONAUTICAL. Comprehensive full-time technical and practical training for careers in all branches of aviation engineering. Diploma course leads to interesting executive appointments in civil aviation design and development draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examinations.—Write for prospectus to Senior Master, College of Aeronautical Engineering, Chelsea, London, S.W.3. Flaxman 0021. [0019

WORK WANTED

TECHNICAL Illustrator, fully experienced, requires free lance work.—Please write Box 1720. [3281

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

SENIOR TECHNICAL ENGINEER

THE Bristol Aeroplane Company Limited are inviting applications from suitably qualified and experienced technical engineers for a senior technical appointment in their London Design Offices at Hay-Market House.

THE duties will include the control of a large design section responsible for the structural analysis of various aircraft. Experience of this type of work and some experience of staff supervision is essential.

A DEGREE in engineering, mathematics or science, or an equivalent professional qualification such as A.F.R.Ae.S. or A.M.I.Mech.E. is desirable.

APPLICATIONS, quoting L.D.O.2, giving details of age, experience, qualifications and salary required, should be addressed to the Personnel Manager, Aircraft Division, The Bristol Aeroplane Company, Limited, Filton House, Filton, Bristol. [3229

SENIOR AIRCRAFT STRESSMEN

and

AIRCRAFT DESIGNERS

required immediately for work on rocket-powered aircraft installations. The appointments would be to senior staff, and permanent. Five-day week, luncheon canteen, superannuation and social club facilities.

PLEASE write in confidence, stating age and giving full details of previous experience in chronological order, to:—
The Personnel Officer,
THE DE HAVILLAND ENGINE CO., LTD.,
Stag Lane, Edgware, Middlesex.
[3223

SKYWAYS, LTD.

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also

ENGINEER OFFICERS

Top rates for men with full "O" licence endorsed for Hermes. Will also consider applicants with "O" licences or ex-R.A.F. engineers with Hastings experience for training.

APPLY giving full details and qualifications to:
Personnel Manager,
SKYWAYS, LTD.,
7 Berkeley Street,
London, W.1.
[3277

MANUFACTURERS of precision aircraft components offer permanent and progressive posts to engineers interested in development of power-operated flying controls, hydraulic systems and fuel metering systems. Expenses paid to applicants attending interviews.—Apply giving age, full details of education, experience and salary required to: H. M. Hobson, Ltd., Fordhouse, Wolverhampton, Staffs. [3245

SITUATIONS VACANT

TECHNICAL ASSISTANTS FOR FLIGHT AND PERFORMANCE

ARMSTRONG SIDDELEY MOTORS require young engineers interested in tests covering performance measurement, handling and control behaviour, analysis of flight test data, prediction of engine performance and the functional side of engine behaviour. Applicants must possess a Degree or Higher National Certificate in Mechanical Engineering. Application quoting reference CG/FP4, to the Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3148

GUIDED WEAPONS—TECHNICAL AUTHORS

THE Guided Weapons Department of the Bristol Aeroplane Company, Limited, at Filton requires to recruit assistant technical authors.

EXPERIENCE of technical writing is desirable, especially in the mechanical field.

APPLICATIONS, quoting D.O.32, giving details of age, experience and salary required, should be addressed to the Personnel Manager, Aircraft Division, The Bristol Aeroplane Company, Limited, Filton House, Bristol. [3210

ARMSTRONG SIDDELEY MOTORS, Coventry, have vacancies for

Technical Writers

Planning Engineers

for work on gas turbine aero engines. Apply to Reference D1, Personnel Manager, Armstrong Siddeley Motors, Coventry. [3188

AERONAUTICAL engineer required, age 25/35. H.N.C. or degree standard necessary. Good works experience preferable with apprenticeship on aircraft engines.

KNOWLEDGE of inspection and test procedures essential. Vacancy in North Midland area where duties primarily concerned with type and modification approval and operational development.

VACANCY in London area where duties primarily concerned with engine performance and type approval. Permanent position.

SALARY according to qualifications and experience. Superannuation scheme in force.

AIR REGISTRATION BOARD, Brettenham House, Strand, London, W.C.2. [3221

LARGE engineering organization in Home Counties requires:—

TWO research engineers with B.Sc. degrees.

TWO design draughtsmen with Higher National Certificate.

WRITE giving full history and personal particulars together with salary expected to Box 1449. [3209

A. V. ROE AND COMPANY, LIMITED, have the following vacancies in the Electronics Laboratory at Greengate:—

(a) Technicians are required who possess a degree in physics or electrical engineering for work on the development of electronic computing equipment for use in the design office. The electronics department is expanding and is likely to take in many diverse fields of development. Preference will be given to applicants who have had some practical experience.

(b) Technicians are also required who possess an honours mathematics degree for work in connection with programming digital computors which will involve the breaking down of differential equations of the type met with in aircraft structural analysis into forms suitable for arithmetical analysis.

Applications, stating full details of age, qualifications and experience, should be addressed to the Labour Manager, A. V. Roe and Company, Limited, Greengate, Middleton, Manchester. [3180

AIRFRAME riggers and detail fitters. Good prospects for experienced men.—Apply to Rollasons, Croydon Airport, Surrey. Tel.: CROydon 5151. [3226

FERRY AIRPORTS, LTD., require engineers, Pratt and Whitney 1830 C licence for permanent position at our Ferryfield base.—Apply to Personnel Office, Blackbushe Airport, Camberley, Surrey. [3274

DLICENSED engineer required for permanent residence in Kenya with charter firm. Queen IIs, etc. Salary up to £1,200 per annum for really good man.—Write Box 1695. [3265

NAVIGATIONAL Instructors for professional Pilot and Navigator qualifications. P/Nav. Certificate or equivalent. Pilot experience preferable. London area. Prospects.—Box 1627. [3246

EXPERIENCED radio mechanics required for overhaul and maintenance base at London Airport. Good rates of pay and conditions.—Write Box F118, L.P.E., 55, St. Martin's Lane, London, W.C.2. [3258

AIRCRAFT inspectors required for details, major assemblies, final erection and flight shed work. Good pay and prospects for suitable men.—Apply stating age and particulars of experience to: Personnel Officer, Hawker Aircraft (Blackpool), Ltd., South Shore, Blackpool. [3220

WELDER-FITTER wanted. Experienced in welded steel tube aircraft essential. Permanent job London area. A.R.B. approved or approvable.—Reply details experience, salary required. Box 1577. [3263

AIRCRAFT electrical design draughtsmen required. Excellent opportunities for advancement.—Apply Personnel Department, Vickers-Armstrongs, Ltd., Hursley Park, nr. Winchester. [3218

SKYWAYS require experienced radio officers immediately.—Reply giving full details of qualifications to Personnel Manager, Skyways, Ltd., 7 Berkeley St., W.1. [3219

ENGINEER required, to be stationed in Nairobi. Licensed on Hermes and Bristol engines preferred. Other applicants, capable of approval, would be considered.—Box 1629. [3249

AIRCRAFT company, about to extend its fleet, with British and American aircraft, including Hermes, invites applications from Aircraft Engineers. Applicants will realize the high degre of skill and organizing ability this position demands.—Box 1628. [3248

ROLLS-ROYCE (Motor Car Division) have immediate vacancies for chassis detail draughtsmen. Salary according to age, experience and qualifications, excellent prospects. Apply immediately: Personnel Manager, Pyms Lane, Crewe. [3254

OLD-ESTABLISHED aviation company located in South West, in Exeter area, are considering establishing a design and drawing office. Applications are invited from: design draughtsmen, senior and intermediate stressmen, detail draughtsmen.

APPLICANTS should be well qualified men to justify good commencing salary.—Write in confidence, giving full details of experience to Box 1661. [3259

SERVICE engineer required for aircraft electro-pneumatic equipment, preferably with some electronic knowledge.—Apply Service Manager, Teddington Aircraft Controls, Ltd., Cefn Coed, near Merthyr Tydfil, South Wales. [3271

THE DE HAVILLAND AIRCRAFT CO., LTD., Airspeed Division, Christchurch, nr. Bournemouth, Hants, require technical assistant for Functional Testing Laboratory. Experience of design and operation of functional test rigs of aircraft systems essential.

HIGHER National Certificate an advantage, but not essential.—Write giving full details of past experience, etc., to above address. [3202

JIG and tool draughtsmen required by D. Napier and Son, Ltd., Luton Airport. Previous experience in this work desirable with at least O.N.C. standard. Please send fullest particulars to Dept. C.P.S., 336/7 Strand, W.C.2, quoting Ref. 145G. [3240

DRAUGHTSMEN TECHNICIANS—LOFTSMEN

The Bristol Aeroplane Company Limited is centralising its London Aircraft Design Offices in Haymarket House, Haymarket, London, S.W.1, and is expanding its design team.

A unique opportunity is offered to experienced draughtsmen, technicians and loftsmen to join design teams engaged upon Civil and Military Aircraft contracts, in both the fixed wing and rotating wing fields.

A progressive CAREER is offered, where ABILITY merits RAPID PROMOTION; where the FINEST WORKING CONDITIONS are being built up in the most CENTRAL POSITION IN LONDON, where SALARIES are appropriate to experience and qualifications, and where a contributory PENSION SCHEME ensures the FUTURE.

The following are required:—

(a) **Intermediate, Senior and Design Draughtsmen** for the Structures, Systems, Electrics and Mechanical Sections. Some Juniors may be considered for training.

(b) **Intermediate and Senior Loftsmen** for the aircraft Full Scale Layout Section.

(c) **Intermediate and Senior Technical Engineers** for the Structures Analysis and Aeroelasticity Sections. A degree or Higher National Certificate in Aeronautical, Mechanical or Structural Engineering is required.

(d) **Weights Engineers** for the Weight Estimating and Control Section.

Applications, giving details of experience, qualifications, quoting L.D.O.1, should be addressed to the **Design Administration Engineer, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Filton, Bristol.** Interviews can be arranged either in London or Filton.

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(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

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—work on high efficiency light alloy structures. Good knowledge of materials and manufacturing technique essential. Ref. D.1.

—layout of ground or airborne Radar and Electronic Equipment. Experience of miniaturization or potting techniques useful. Ref. D.4.

—layout of Electronic Equipment employed in Laboratory Measurements and Monitoring. Previous experience of RCS. 1000 very desirable. Ref. D.5.

—design of Special Laboratory Test Rigs used for Research and Development of light hydraulic components. Previous experience of hydraulic or pneumatic systems an asset. Ref. D.11.

—work on precision electro-mechanical instruments and gyroscopes. Previous experience of design for close tolerance manufacture of diecasting an advantage. Ref. D.12.

DETAIL DRAUGHTSMEN for light mechanical work associated with aircraft structures and installation of special components. Knowledge of electrical or hydraulic systems an advantage. Ref. D.2.

These positions carry attractive salaries and promotion prospects, and are pensionable after qualifying period. Housing assistance can be given in some cases. Please apply to:—

DEPT. C.P.S.,
336/7 STRAND W.C.2
quoting Ref. 1119P.

TECHNICAL ENGINEERS

The Aircraft Technical Office of the

BRISTOL AEROPLANE CO. LTD. AT FILTON

requires to recruit

TECHNICAL ENGINEERS

with mathematical or engineering degrees.

They will be required to undertake Numerical Analysis involving the application of electronic computers to the solution of aircraft design problems.

Applications, quoting D.O.34, giving details of age, experience, qualifications and salary required, should be addressed to the **Personnel Manager, Aircraft Division, Bristol Aeroplane Co. Ltd., Filton House, Bristol.**

SITUATIONS VACANT

AIRCRAFT electricians required by Skyways, Ltd., at Bovingdon Airport. Tel.: Bovingdon 2143, or write for interview to Administrative Superintendent, Skyways, Ltd., Bovingdon Airport, nr. Hemel Hempstead, Herts. [3269

EXPERIENCED aircraft radio engineer with "A" radio licence required by Skyways for post in Teheran. Good salary and local cost-of-living allowance. Single man preferred.—Write with full details of qualifications to Personnel Manager, Skyways, Ltd., 7 Berkeley Street, London, W.1. [3261

WANTED, aircraft engine fitter, preferably ex-Service with Cheetah and Gipsy engine experience. Also aircraft radio mechanic, ex-Service, to work on Oxford and Chipmunk aircraft.—Apply: Birkett Air Service, Ltd., R.A.F. Station, Castle Bromwich. [3284

ISLAND AIR SERVICES require young man as traffic handler for pleasure flights at London Airport, starting Easter for five months. Five-day week. Must be keen and interested in aviation. One preparing to go into R.A.F. for National Service preferred. —Apply giving full particulars to Box 1739. [3283

PRODUCTION control superintendent required by leading aircraft company on South Coast. Previous similar experience essential. Staff assurance and pension fund.—Write, stating age, details of previous and present employment and salary expected, in confidence, to Box 1740. [3285

HELLIWELS, LTD., Aircraft Division, Elmdon Airport, Birmingham, have vacancies for Two Design Section Leaders for interesting aircraft design work of high priority. Only first class aircraft men will be considered, but excellent rates will be paid to the successful applicants. Full details of training and experience, etc., to Personnel Manager. [3250

APPLICATIONS are invited for post of Senior Draughtsman with a well known company of instrument manufacturers. Experience in design of small electro-mechanical devices is essential. Salary in accordance with experience. Employment agencies are invited to reply.—Write, Box 2548, Frost-Smith Advg., 64 Finsbury Pavement, London, E.C.2. [3251

FERRANTI Limited, Edinburgh, have vacancies for Aircraft Draughtsmen. Experience in aircraft installation work desirable but not essential. Apply, quoting Ref. 29 D.D.O., and give full details of training and experience in chronological order to the Personnel Officer, Ferranti, Limited, Ferry Road, Edinburgh 5. [3247

ARMSTRONG SIDDELEY MOTORS have vacancies for design draughtsmen and senior draughtsmen for work on latest development in gas turbine aero engines and rocket motors. Pension and superannuation schemes. Good prospects and salaries. —Apply to Reference CG/DSD, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3181

RADIO engineer licenced "A" and "B" required to take charge of radio overhaul and maintenance of large operator at London Airport. Vacancies also exist for licensed assistant to above and licensed engineers for base and out station. Salary in accordance with qualifications.—Write Box F119, L.P.E., 55 St. Martin's Lane, London, W.C.2. [3257

SENIOR technical illustrator (male) required by Hunting Percival Aircraft, Limited, Luton Airport, Beds., for work on A.M. publications. Good welfare facilities, including staff pension scheme.—Applications, stating full details of qualifications, experience, age and salary required, to be forwarded to Personnel Manager. [3225

KING AIRCRAFT CORPORATION, manufacturers of aircraft components, urgently require senior and junior jig and tool draughtsmen. Applicants should have sound qualifications and, in particular, experience in press tool design. Application should be made in writing to the Works Manager at Cameron Street, Hillington, Glasgow, S.W.2. [3242

HELICOPTER stress engineers required for work on new types of Civil and Military aircraft and helicopters. Previous stressing experience preferred, but not essential. Degree or H.N.C. desirable. Good salaries and staff pension scheme.—Apply, giving full particulars of training and experience, and stating age and salary required to Personnel Manager, Hunting Percival Aircraft Limited, Luton Airport, Beds. [3241

ARMSTRONG SIDDELEY MOTORS has vacancies for technical assistants in their main engine development department. The work deals with the development of all types of the company's aero engines from their earliest inception. Applicants must possess at least a Higher National Certificate in Mechanical engineering. Being an expanding department the prospects and initial salary are good.—Apply to Reference CG/X2, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3256

JUNIOR or intermediate engineers for Vibration Section. Applicants should have had some experience with mechanical vibration problems, and the application of electronic and similar methods of measurement generally. Experience of oscillograph record analysis would be an additional advantage. Applicants should be at least up to degree standard, but direct experience will be set against academic qualifications. Salary in accordance with experience and qualifications. Staff pension scheme and excellent working conditions. —Applications giving details of experience, qualifications and salary required, quoting E.D.17, should be addressed to the Personnel Manager, The Bristol Aeroplane Company, Limited, Engine Division, Filton House, Bristol. [3211

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2. SENIOR ELECTRICAL ENGINEERS
Good degree with wide and sound experience in electrical and/or electronic engineering.

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Qualification, preferably degree, coupled with creative ability in light electrical engineering.

4. TECHNICAL ILLUSTRATORS—ELECTRICAL

5. DRAUGHTSMEN
Mechanical and Electrical for Design Department and Jig and Tool Draughtsmen. H.N.C. preferred, but chief requirement is designing ability with knowledge of modern techniques.

6. PROCESS AND TOOL PLANNING ENGINEERS
Skilled craftsmen with detailed knowledge of modern aircraft manufacturing methods.

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Varied practical and preferably also Ratefixing experience.

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Openings occur from time to time in Accounts, Buying and other departments for young men of Grammar School education and good clerical ability. Positions for ladies as Shorthand Typists, Typists and Clerks.

Write quoting this advertisement and reference number to:

THE PERSONNEL SUPERVISOR, HAWKER AIRCRAFT LTD., CANBURY PARK ROAD, KINGSTON-ON-THAMES, SURREY

TECHNICAL ASSISTANTS

The Aircraft Equipment Section (Aircraft Design Office) of the

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requires to recruit

TECHNICAL ASSISTANTS

Experience of Ministry of Supply and Air Registration Board procedures as applied to Aircraft Equipment is essential.

Applications, quoting D.O.33, giving details of age, experience and salary required, should be addressed to the

Personnel Manager, Aircraft Division, Bristol Aeroplane Co. Ltd., Filton House, Bristol.

SITUATIONS VACANT

SENIOR Planning Engineer required by airline at base in Home Counties, previous experience in busy planning office essential, preferably in aircraft industry. Salary according to qualifications and experience, but not less than £900 per annum.—Write with full details to Box 1719. [3280

SENIOR and intermediate design draughtsmen with aircraft and mechanical engineering experience required. The work will interest men who can apply their design ability to the development of new equipment which has a steadily growing application. Pleasant working conditions; 5-day week. Within easy reach of Bournemouth. Special transport facilities provided. —Apply in writing to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, near Blandford, Dorset. [3270

ENGINEERING assistant required with experience in dealing with experimental mechanical problems, preferably associated with gas turbines and auxiliaries. Training to a good degree standard with practical experience and appreciation of research and development. Vacancy offers considerable scope for engineering initiative. Good salary and pension scheme.—Full particulars, quoting E.D.26, to be forwarded to the Personnel Manager, The Bristol Aeroplane Company, Limited, Engine Division, Filton House, Bristol. [3208

PROCESS ENGINEERS

Previous experience as such not necessary if applicants are skilled tradesmen with detailed knowledge of modern aircraft manufacturing methods gained by some years' practical experience.

Write to PERSONNEL OFFICER,
HAWKER AIRCRAFT LTD.
CANBURY PARK ROAD,
KINGSTON-ON-THAMES,
SURREY

STRESSMAN, junior or intermediate wanted for interesting work on structural reinforced plastics. H.N.C. minimum standard. Excellent opportunity for advancement. Good salary and working conditions.—Write full details to Man. Dir., Microcell, Ltd., 56 Kingsway, London, W.C.2. [3266

PERMANENT and progressive posts are offered to design and detail draughtsmen interested in hydraulic flying control equipment for aircraft and guided missiles, as well as fuel systems for rocket motors, ramjets and gas turbines. Expenses paid to applicants attending interviews.—Apply giving age, full details of education and experience to: H. M. Hobson, Ltd., Fordhouses, Wolverhampton, Staffs. [3190

ASSISTANT aerodynamist required. Good salary and prospects for a man with aerodynamics and mathematics to degree standard. Industrial experience preferable but not essential. Applicants must be British by birth and free of National Service commitments (Ref. 63).—Please write in detail, quoting Reference No. to: The Personnel Manager (Technical Employment) de Havilland Propellers, Limited, Hatfield, Herts. [3191

PLANNING engineers required by Hunting Percival Aircraft Limited. Experience in manufacture, installation and production planning of metal airframe components essential. Good welfare facilities, including staff pension scheme.—Applications, stating age, salary required, and full details of experience to Personnel Manager, Hunting Percival Aircraft Limited, Luton Airport, Beds. [3207

TECHNICAL sales engineer required by company designing and producing laminated compressed wood and steel rubber and mechanical press tools, drill and router jigs, etc., to cover North of England and Scotland, working from Manchester office. Technical knowledge and experience of press tools essential. Excellent prospects. Applicants between 25 and 38 should apply at once giving educational details and stating salary required to Sales Director, Hordern-Richmond (Sales), Ltd., Haddenham, Bucks. [3255

BRITISH EUROPEAN AIRWAYS require Draughtsmen at London Airport. Minimum of two years' aircraft drawing office experience essential. Higher National Certificate desirable. Salary £8 6s. 0d. p.w. at 21 to £11 7s. 6d. p.w. at 25; additional proficiency pay earnable. After qualifying periods, pension and sick pay schemes, three weeks' holiday, air travel concessions. Written detailed applications to Senior Personnel Officer, B.E.A. Engineering Base, London Airport, Hounslow, Middlesex. [3281

BLACKBURN & GENERAL AIRCRAFT, LTD., Brough, E. Yorks, require female staff to be trained for the computing section of their Technical Design Office. The educational qualifications required are G.C.E. advanced, i.e. Inter B.Sc. level or passed degree level for the senior positions and G.C.E. for the junior. The work requires reasonably intelligent understanding of mathematical symbols, the use of logarithms and trigonometrical functions. This is an opportunity for girls with the right educational qualifications to enter the technical side of the aircraft industry. —Applications in writing please to the Personnel manager at the above address. Mark envelopes— "Computer." [3267

SITUATIONS WANTED

EX-R.A.F. pilot, 3,500 hours, C.P.L., I/R., R/T., seeks change, home or abroad, ground or air. Experienced single-twin-multi.—Box 1713 [3276

FOR ferry flight pilot to Europe or Middle East contact flying instructor, 1,000 hrs.; singles, twins; with three weeks holiday due shortly.—Box 1738. [3282

JIG AND TOOL DRAUGHTSMEN

Applicants if not already experienced as such should be competent at drawing and have sound practical toolroom experience, plus knowledge of latest techniques. Previous experience in aircraft not essential. Superannuation.

Write PERSONNEL OFFICER
HAWKER AIRCRAFT, LTD.
CANBURY PARK ROAD,
KINGSTON-ON-THAMES,
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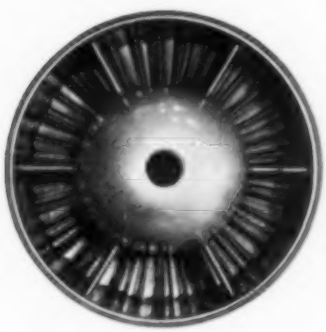

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